HA12155NT/HA12157NT

Audio Signal Processor for Cassette Deck (Dolby B/C-type NR with Recording System)

HITACHI

ADE-207-115C (Z)
4th Edition
June 1997

Description

HA12155NT/HA12157NT is silicon monolithic bipolar IC providing Dolby noise reduction system*, electrical volume system, REC equalizer system and level meter system in one chip.

Functions

- REC equalizer × 2 channel
- Dolby B/C NR × 2 channel
- Electronic volume × 2 channel
- Level Meter × 2 channel

Features

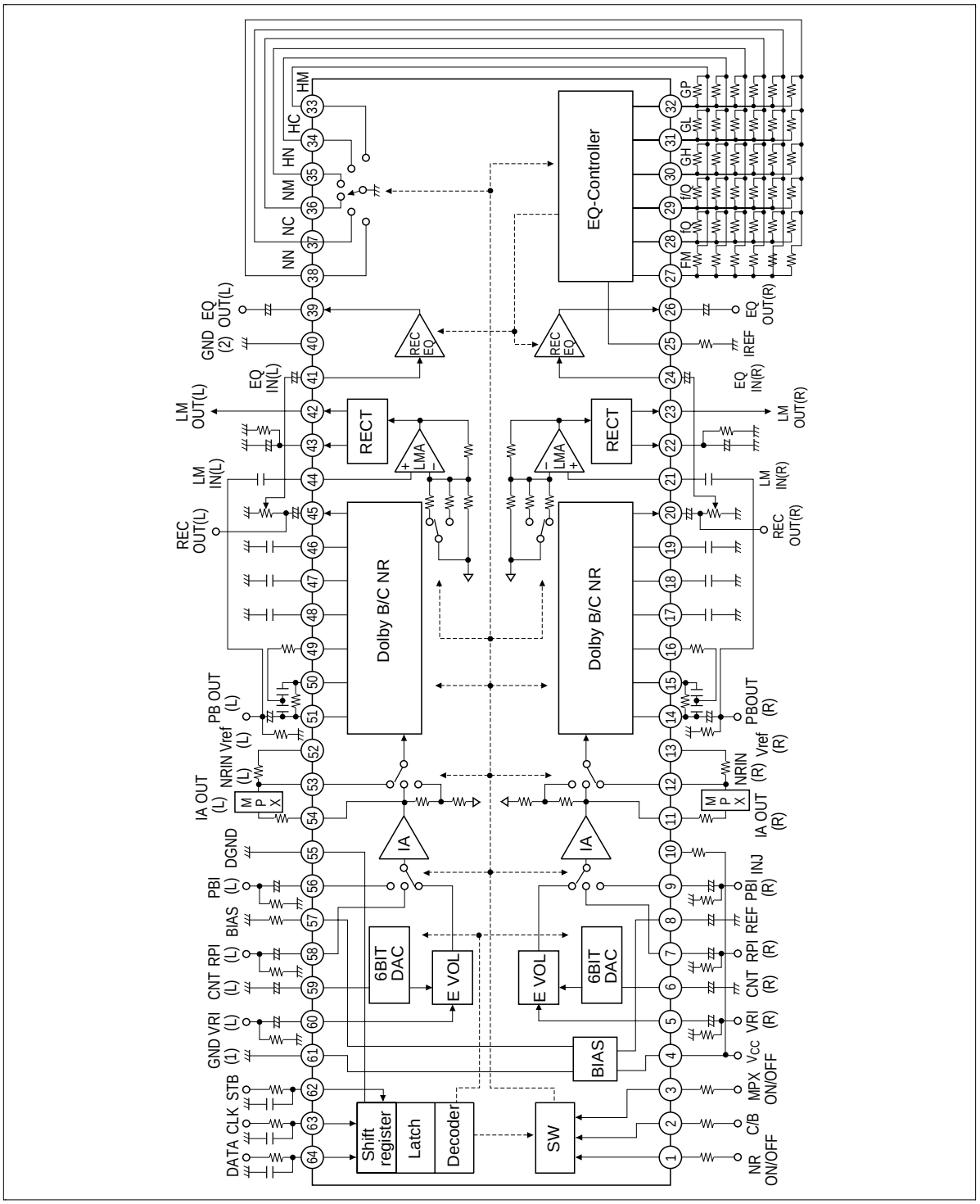
- Inductor less REC equalizer is adjustable of its characteristics by external resistor
- Rec level is adjustable automatically with electrical volume which is built-in
- 3 type of input selection is available (one is by way of electrical volume)
- Separate input selection SW and REC/PB SW
- Dolby noise reduction with dubbing cassette decks
  (Unprocessed signal output available from recording out terminals during PB mode)
- Log-compressed level meter output is range from 0 V to 5 V
  (Usable as music search switchable gain of 0 dB and 20 dB respectivily)
- Normal-speed/high-speed (Double), normal/metal/chrome fully electronic control switching built-in
- NR-ON/OFF, Dolby B/C, MPX ON/OFF fully electronic control switching built-in
  (Controllable from micro-controller directly)
- Reduction of number of pin by transfered serial data to electronic volume control switching and another control switching
  (Controllable from micro-controller directly)
- Low external parts count

Hitachi semiconductor

Ordering Information

Type	Package	Dolby Level	REC-OUT Level	PB-OUT Level	Operating voltage	
					Min	Max
HA12155NT	DP-64S	300 mVrms	300 mVrms	580 mVrms	9.5 V	16 V
HA12157NT				775 mVrms	12 V	16 V

Block Diagram



Absolute Maximum Ratings

Item	Symbol	Ratings	Unit
Supply voltage	V_{CC}	16	V
Power dissipation*1	Pd	770	mW
Operating temperature	Topr	–30 to +75	°C
Storage temperature	Tstg	–55 to +125	°C

Note: 1. Value at Ta ≤ 75°C

Electrical Characteristics (Ta = 25°C V_{CC} = 14 V Dolby level 300 mVrms)

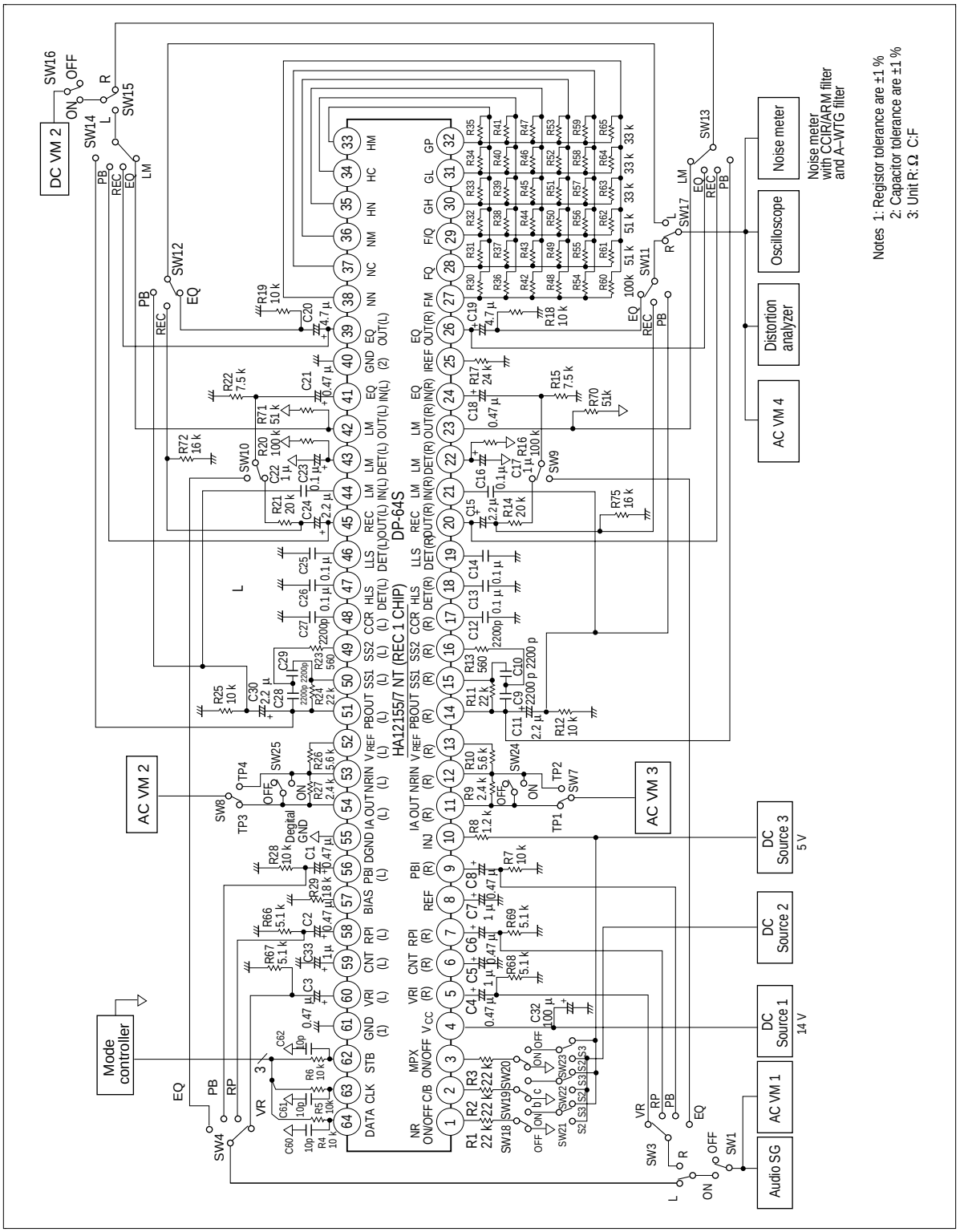
Item		Symbol	Min	Typ	Max	Unit	Test conditions	Notes
Quiescent current		I_Q	—	29.0	37.0	mA	no signal	
Input amp gain		G_{VIA} RPI	18.5	20.0	21.5	dB	Vin = 0 dB, f = 1 kHz	
		G_{VIA} PBI	18.5	20.0	21.5			
B-type NR Encode Boost		B-ENC-2K	2.8	4.3	5.8	dB	Vin = –20 dB, f = 2 kHz	
		B-ENC-5K	1.7	3.2	4.7		Vin = –20 dB, f = 5 kHz	
C-type NR Encode Boost		C-ENC-1K(1)	3.9	5.9	7.9	dB	Vin = –20 dB, f = 1 kHz	
		C-ENC-1K(2)	18.1	19.6	21.6		Vin = –60 dB, f = 1 kHz	
		C-ENC-700	9.8	11.8	13.8		Vin = –30 dB, f = 700 Hz	
Signal handling		Vomax	12.0	13.0	—	dB	f = 1 kHz, THD = 1%, V_{CC} = 12 V	*1
Signal to noise ratio		S/N	60.0	63.0	—	dB	Rg = 5.1 kΩ, CCIR/ARM	
Total harmonic distortion		THD	—	0.08	0.3	%	Vin = 0 dB, f = 1 kHz	
Crosstalk		C_T (R↔L)	—	–85.0	–79.0	dB	Vin = 0 dB, f = 1 kHz	
		C_T (RPI↔PBI)	—	–80.0	–74.0			
		C_T (VRI↔RPI)	—	–77.0	–71.0			
Control voltage	Hi level	V_{cH}	3.5	—	5.3	V	MPX ON/OFF, NR	
	Lo level	V_{cL}	–0.2	—	1.0		ON/OFF C-NR/B-NR	
Serial data voltage	Hi level	V_{sH}	3.5	—	5.3	V	CLK, DATA, STB	
	Lo level	V_{sL}	–0.2	—	1.0			
PB-out level	HA12155	Vout	500	580	670	mVrms	Vin = 0 dB, f = 1 kHz	
	HA12157		665	775	900			
PB-offset		Vofs	–100	0.0	+100	mV	no signal	
Channel balance		ΔG_V	–1.0	0.0	1.0	dB	Vin = 0 dB, f = 1 kHz	
Volume gain		$G_{VVR (MAX)}$	17.5	19.3	21.5	dB	Vin = 100 mVrms, f =1 kHz	
		$G_{VVR (MIN)}$	—	—	–55.0		Vin = 3 Vrms, f = 1 kHz	

Electrical Characteristics (Ta = 25°C V_{CC} = 14 V Dolby level 300 mVrms) (cont)

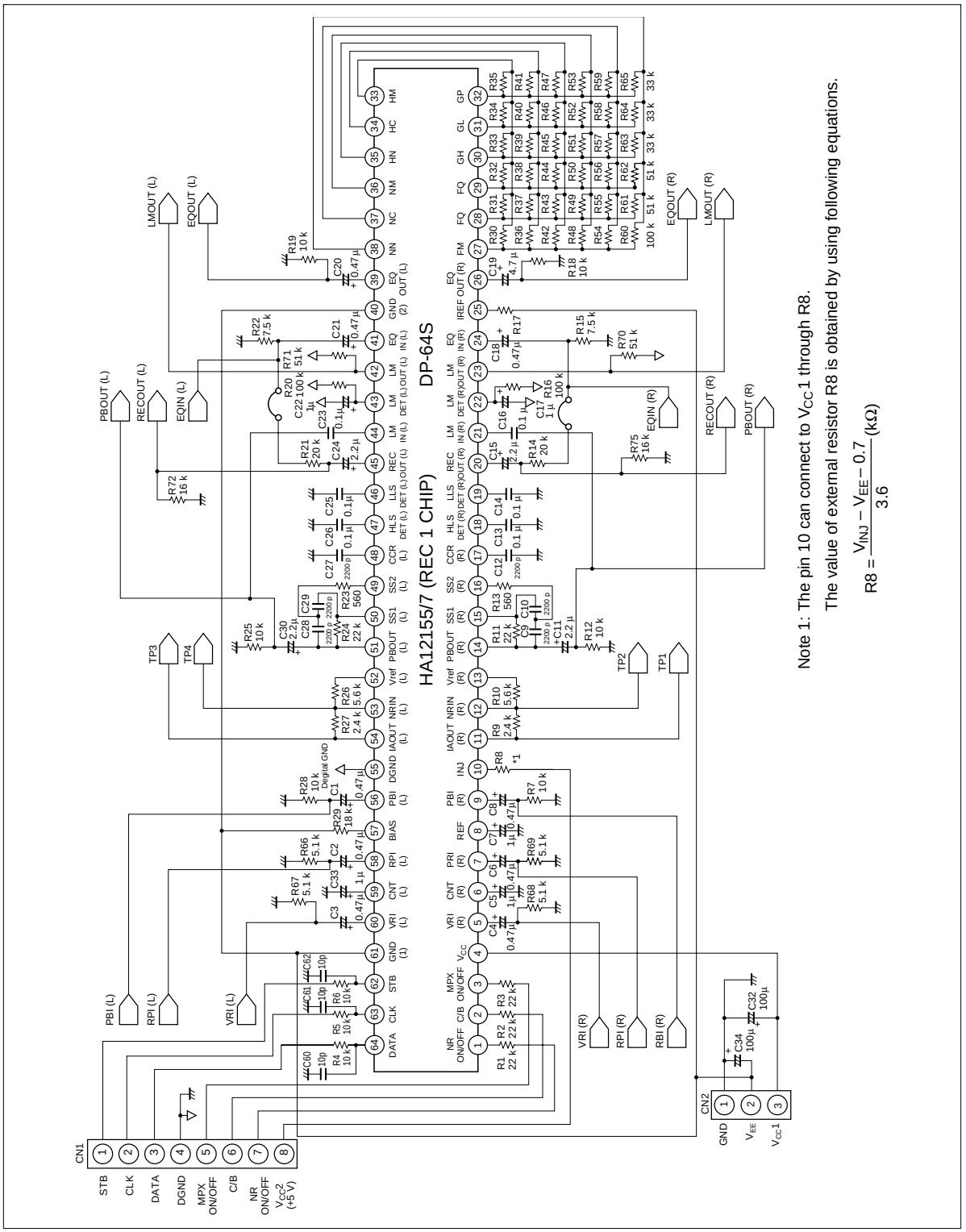
Item	Symbol	Min	Typ	Max	Unit	Test conditions	Notes
Volume mute	$G_{VVR\ (MUT)}$	—	—	–80.0	dB	Vin = 3 Vrms, f = 1 kHz	
Max-input level to volume	Vin max (VR)	11.0	12.6	—	dBs	f = 1 kHz, THD = 1%, V_{CC} = 12 V	
Volume S/N	S/N (VR)	78.0	84.0	—	dB	Vin = 100 mVrms, f = 1 kHz, A-WTG	
Volume THD	THD (VR)	—	0.04	0.3	%	Vin = 100 mVrms, f = 1 kHz	
Equalizer gain	$G_{V\ EQ\ (500)}$	13.0	15.0	17.0	dB	Vin = 77.5 mVrms, f = 500 Hz	
	$G_{V\ EQ\ (1K)}$	13.0	15.0	17.0		Vin = 77.5 mVrms, f = 1 kHz	
	$G_{V\ EQ\ (5K)}$	14.5	16.5	18.5		Vin = 77.5 mVrms, f = 5 kHz	
	$G_{V\ EQ\ (10K)}$	18.5	20.5	22.5		Vin = 77.5 mVrms, f = 10 kHz	
	$G_{V\ EQ\ (20K)}$	29.5	32.0	34.5		Vin = 77.5 mVrms, f = 20 kHz	
Equalizer maximum input	Vin max (EQ)	–8.0	–7.0	—	dBs	f = 1 kHz, THD = 1%, V_{CC} = 12 V	*1
Equalizer S/N	S/N (EQ)	57.0	62.0	—	dB	Rg = 5.1 kΩ, A-WTG	
Equalizer THD	THD (EQ)	—	0.2	0.5	%	Vin = 77.5 mVrms, f = 1 kHz	
Equalizer offset	Vofs (EQ)	–400	0.0	+400	mV	no signal	
Level meter output	LM (0 dB)	2.60	2.85	3.10	V	Vin = 0 dB, f = 1 kHz	*2
	LM (12 dB)	3.60	3.90	4.20	V	Vin = 12 dB, f = 1 kHz	
Level meter output	LM (–20 dB)1	0.80	1.10	1.40	V	Vin = –20 dB, f = 1 kHz	*2
	LM (–20 dB)2	2.55	3.0	3.15	V	Vin = –20 dB, f = 1 kHz, –20 dB range	
Level meter offset	LMofs 1	—	150	300	mV	no signal	
	LMofs 2	—	200	350		no signal, –20 dB range	

Notes: 1. HA12155 V_{CC} = 9.5 V, HA12157 V_{CC} = 12 V
2. 0 dB = PB-OUT level

Test Circuit



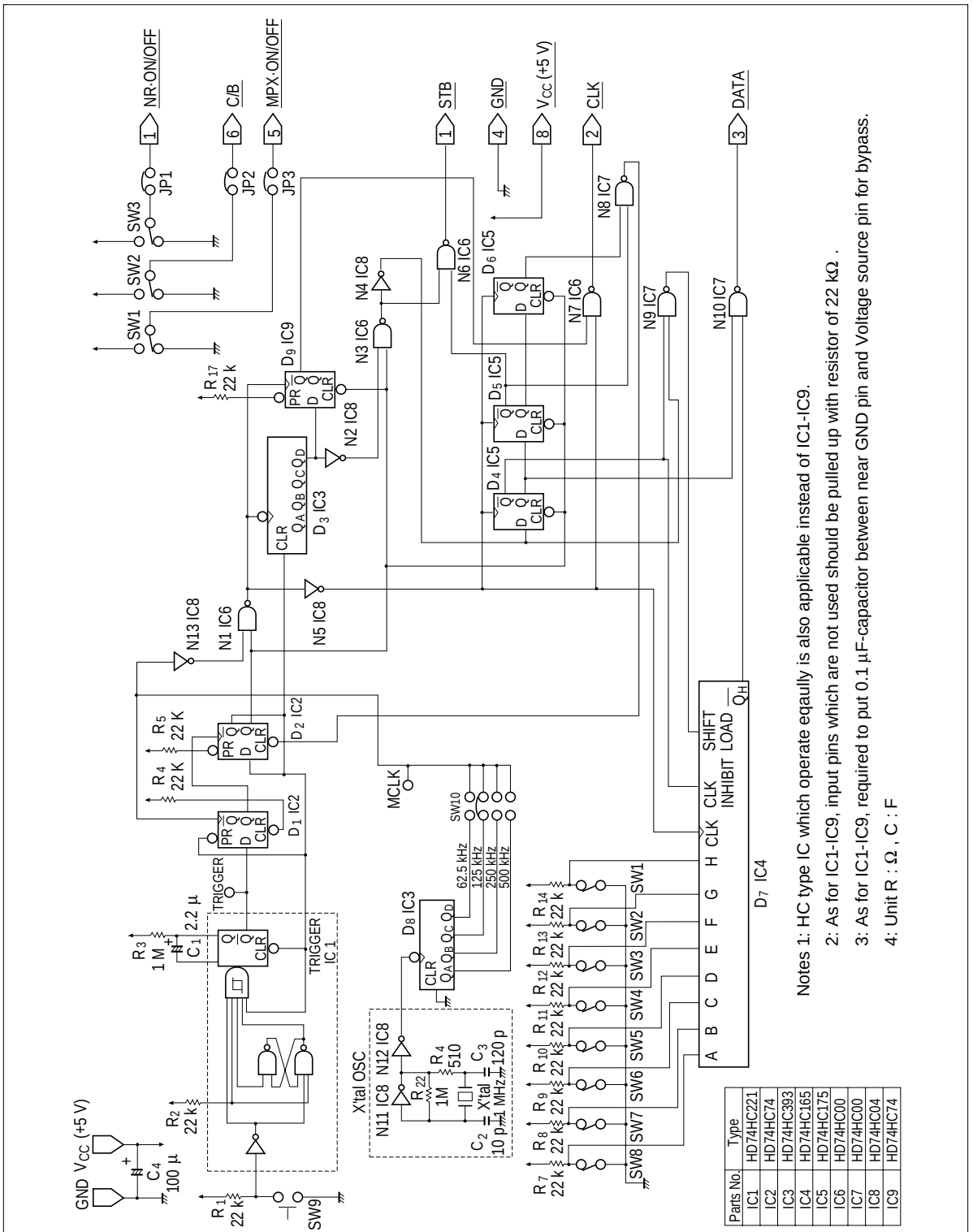
Example of Split Supply Circuit



Note 1: The pin 10 can connect to $V_{CC}1$ through R8.
The value of external resistor R8 is obtained by using following equations.

$$R8 = \frac{V_{INJ} - V_{EE} - 0.7}{3.6}\ (k\Omega)$$

Mode Controller



Notes 1: HC type IC which operate eqaully is also applicable instead of IC1-IC9.

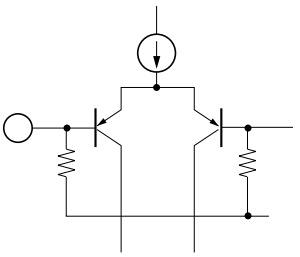
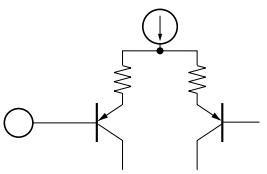
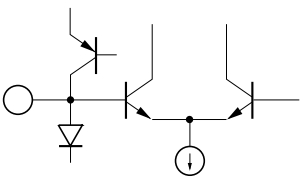
2: As for IC1-IC9, input pins which are not used should be pulled up with resistor of 22 kΩ .

3: As for IC1-IC9, required to put 0.1 µF-capacitor between near GND pin and Voltage source pin for bypass.

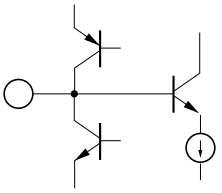
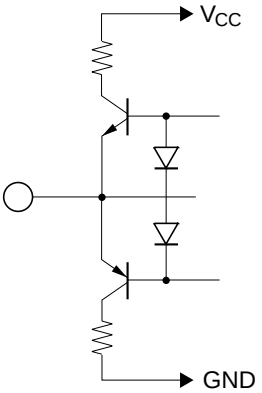
4: Unit R : Ω , C : F

Parts No.	Type
IC1	HD74HC221
IC2	HD74HC74
IC3	HD74HC393
IC4	HD74HC165
IC5	HD74HC175
IC6	HD74HC00
IC7	HD74HC00
IC8	HD74HC04
IC9	HD74HC74

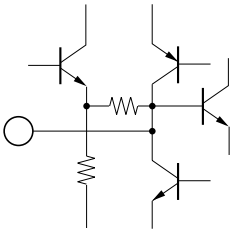
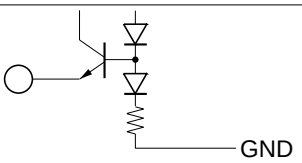
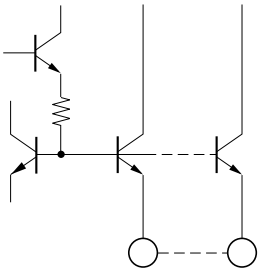
Pin Description (V_{CC} = 14 V, Ta = 25°C, No signal, the value in the table show typical value)

Pin No. DP-64S	Terminal name	Zin	DC voltage	Equivalent circuit	Description
7	RPI	100 kΩ	V_{CC}/2		Recording input
58					
9	PBI				Play back input
56					
21	LM IN	HA12155 ---75 kΩ			Level meter input
44		HA12157 ---100 kΩ			
24	EQ IN	100 kΩ			Equalyzer input
41					
5	VRI	100 kΩ	V_{CC}/2		Volume input
60			+0.7 V		
4	V_{CC}	—	V_{CC}	—	Power supply
8	REF	—	V_{CC}/2	—	Ripple filter
12	NR IN	—	V_{CC}/2		NR processor input
53					
15	SS 1	—	V_{CC}/2		Spectral skewing amp input
50					

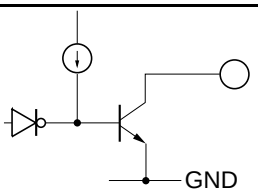
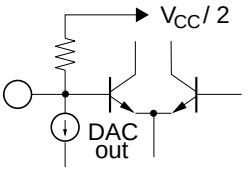
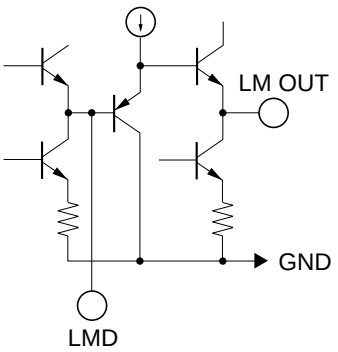
Pin Description (V_{CC} = 14 V, Ta = 25°C, No signal, the value in the table show typical value) (cont)

Pin No. DP-64S	Terminal name	Zin	DC voltage	Equivalent circuit	Description
17 48	CCR	—	$V_{cc}/2$		Current controled resistor output
11 54	IA OUT	—	$V_{cc}/2$		Input amp output
13 52	VREF				Reference voltage buffer output
14 51	PB OUT				Play back (Decode) output
16 49	SS 2				Spectral skewing amp. output
20 45	REC OUT				Recording (Encode) output
26 39	EQ OUT				Equalyzer output

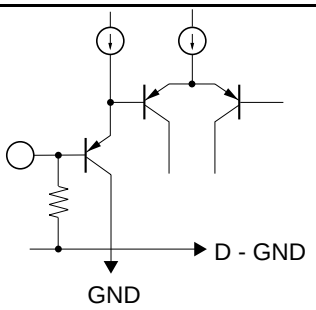
Pin Description (V_{CC} = 14 V, Ta = 25°C, No signal, the value in the table show typical value) (cont)

Pin No. DP-64S	Terminal name	Zin	DC voltage	Equivalent circuit	Description
18	HLS DET	—	2.3 V		Time constant pin for rectifier
47					
19	LLS DET				
46					
57	BIAS	—	0.28 V		Dolby NR Reference current input
25	IREF	—	1.2 V		EQ Reference current input
27	FM				EQ Parameter current input
28	fQ				
29	f/Q				
30	GH				
31	GL				
32	GP				

Pin Description (V_{CC} = 14 V, Ta = 25°C, No signal, the value in the table show typical value) (cont)

Pin No. DP-64S	Terminal name	Zin	DC voltage	Equivalent circuit	Description
33	HM	—	—		EQ Parameter selector
34	HC				
35	HN				
36	NM				
37	NC				
38	NN				
6	CNT	5.2 kΩ	V_{CC}/2-		DAC output Volume
59			1.5 V to V_{CC}/2		control input
22	LMD	—	0.2 V		Time constant Pin for
43					level meter
23	LM OUT	—	0.2 V		Level meter output
42					

Pin Description (V_{CC} = 14 V, Ta = 25°C, No signal, the value in the table show typical value) (cont)

Pin No. DP-64S	Terminal name	Zin	DC voltage	Equivalent circuit	Description
1	NR ON/OFF	100 kΩ	—		Mode control input
2	C/B				
3	MPX ON/OFF				
62	STB				
63	CLK				
64	DATA				
10	INJ	—	0.7 V	—	Injection current input for I^2L
55	D-GND	—	0.0 V	—	Digital (Logic) ground
40	GND	—	0.0 V	—	Ground
61					

Application Note

Power Supply Range

HA12155NT/HA12157NT are designed to operate on either single supply or split supply.

The operating range of the supply voltage is shown in table 1.

Table 1 Supply Voltage

Type No.	Single supply	Split supply
HA12155NT	9.5 V to 16 V	±6 V to 8 V
HA12157NT	12 V to 16 V	±6 V to 8 V

The lower limit of supply voltage depends on the line output reference level.

The minimum value of the headroom margin is specified as 12 dB by Dolby Laboratories. HA12155 series are provided with two line output level, which will permit an optimum headroom margin for power supply conditions.

Reference Voltage

For the single supply operation these devices provide the reference voltage of half the supply voltage that is the signal grounds. As the peculiarity of these devices, the capacitor for the ripple filter is very small about 1/100 compared with their usual value. The Reference voltage are provided for the left channel and the right channel separately. The block diagram is shown as figure 1.

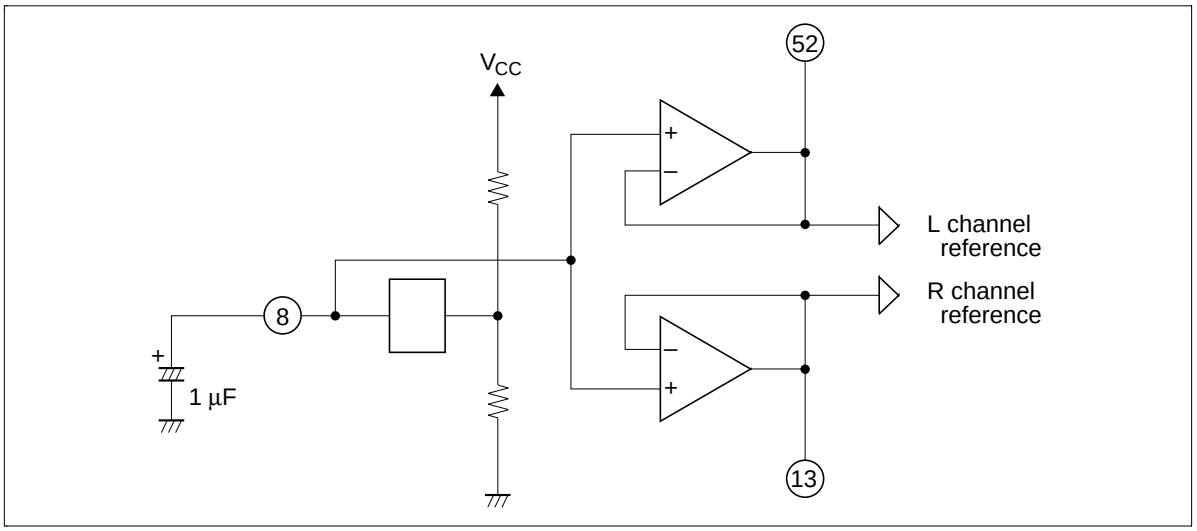


Figure 1 The Block Diagram of Reference Voltage Supply

Operating Mode Control

HA12155NT/HA12157NT provides fully electronic switching circuits. NR-ON/OFF, C/B, and MPX ON/OFF switches are controlled by parallel data (DC voltage) and other switches are controlled by serial data.

Table 2 Threshold Voltage (V_{TH})

Pin No.	Lo	Hi	Unit
1, 2, 3	–0.2 to 1.0	3.5 to 5.3	V
62, 63, 64	–0.2 to 1.0	3.5 to 5.3	V

Notes: 1. Voltages shown above are determined by internal circuits of LSI when take pin 55 (DGND pin) as reference pin. On split supply use, same V_{TH} can be offered by connecting DGND pin to GND pin.

This means that it can be controlled directly by micro processor.

2. Each pins are on pulled down with 100 kΩ internal resistor.

Therefore, it will be low-level when each pins ar open.

3. Note on serial data inputting

(a) The clock frequency on CLK must be less than 500 kHz.

(b) Over shoot level and under shoot level of input signal must be the value shown below.

(c) The serial input pins (pins 62, 63, and 64) are extremely sensitive to undershoot, overshoot, ringing, and noise. This can result in malfunctions due to problems with the wiring pattern. We recommend attaching capacitors in parallel with the serial input pins to ameliorate this problem.

Figure 2-b shows an example of this circuit appropriate when the clock frequency is 500 kHz. The value of the capacitor should be set in accordance with the clock frequency actually used.

4. NR Mode Switching

In actual use, pop noises may accompany NR on/off switching in C mode. To avoid these noises, use the following sequences to turn NR on and off.

From C mode NR off to C mode NR on:

(C mode, NR off) → (B mode, NR off) → (B mode, NR on) → (C mode, NR on).

From C mode NR on to C mode NR off:

(C mode, NR on) → (B mode, NR on) → (B mode, NR off) → (C mode, NR off).

Table 3 Switching Truth Table

Pin No.	Lo	Hi
1	NR-OFF	NR-ON
2	B-NR	C-NR
3	MPX-ON	MPX-OFF

Notes: 1. Low level will be offered when each pins are open.

2. Please refer to next term as for the serial data for formatting.

When connecting microcomputer or Logic-IC with HA12155NT/HA12157NT directly, there is apprehension of rash-current under some transition timming of raising voltage or falling voltage at V_{CC} ON/OFF.

For this countermeasure, connect 10 kΩ to 20 kΩ resistor with each pins. It is shown in test circuit.

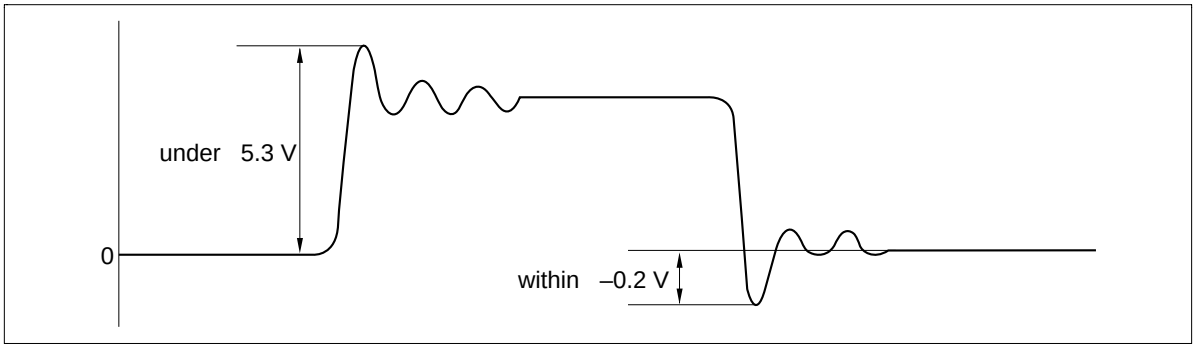


Figure 2 Input Level

Serial Data Formatting

8 bit shift register is employed. CLK and DATA are stored during STB being high and data is ratched when STB goes high to low. The clock frequency on CLK must be less than 500 kHz.

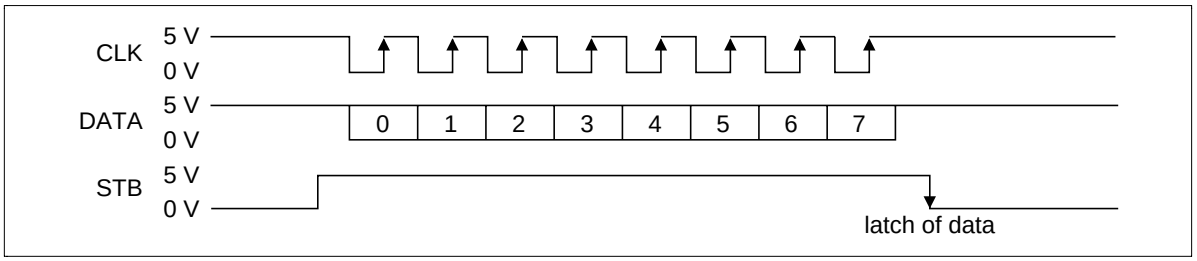


Figure 3 Serial Data Timming Chart

Table 4 Serial Data Formatting

Bit No.	Control register		Volume register			
0	TAPE SELECT 1	H		DAC0		
		L	TS1 \ TS2 / H / L H: TAPE IV / TAPE I L: TAPE II / TAPE I			
1	TAPE SELECT 2	H		DAC1		
		L				
2	TAPE SPEED	H	High (double) speed selection	DAC2		
		L	Normal speed selection			
3	METER SENSITIVITY	H	Meter sensitivity 20 dB up	DAC3		
		L	Meter sensitivity normal			
4	INPUT SELECT 1	H		DAC4		
		L	IS1 \ IS2 / H / L H: PB I / VR I L: RP I / VR I			
5	INPUT SELECT 2	H		DAC 5		
		L				
6	REC/PB	H	PB mode selection	R/L SELECT	H	Rch register selection
		L	REC mode selection		L	Lch register selection
7	REGISTER SELECT	H	Control register selection	REGISTER SELECT	L	Volume register selection

bit No.						
5	4	3	2	1	0	gain
L	L	L	L	L	L	increase
L	L	L	L	L	H	
L	L	L	L	H	L	
L	L	L	L	H	H	
H	H	H	H	L	H	
H	H	H	H	H	L	decrese
H	H	H	H	H	H	mute

*mute is implemented when all bits are high.

Note: TAPE I: Normal tape, TAPE II: Chrome tape, TAPE IV: Metal tape

Input Block Diagram and Level Diagram

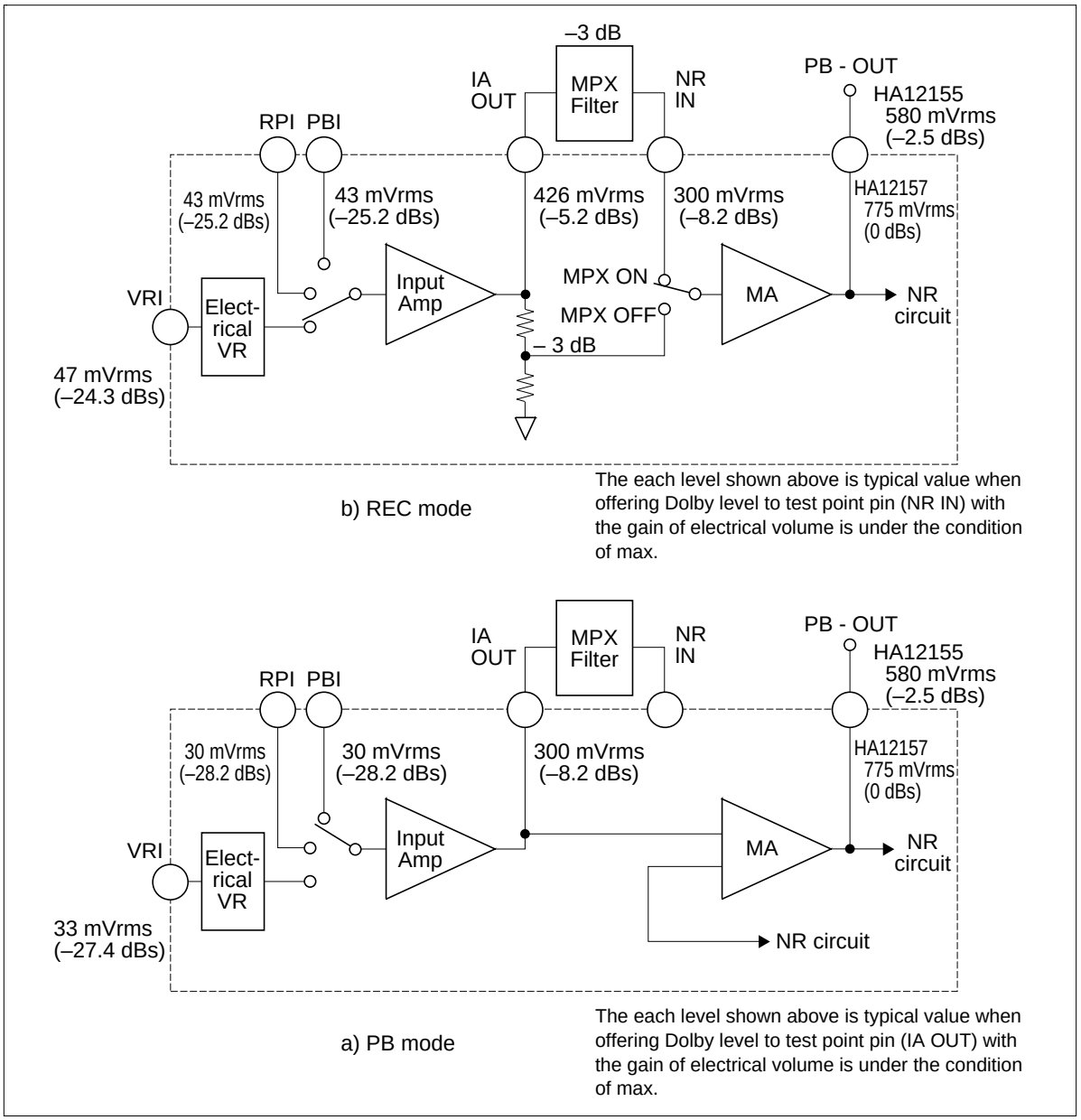


Figure 4 Input Block Diagram

MPX ON/OFF Switch

MPX-OFF mode means that signal from input amp doesn't go through the MPX filter, but signal goes through the SS circuit after being attenuated 3 dB by internal resistor. Refer to figure 5. For not cause any level difference between MPX-ON mode and MPX-OFF mode, it is requested to use MPX-filter which has definitely 3 dB attenuated. MPX-OFF mode offer totally flat frequency response and no bias-trap effect. And when applying other usage except figure 5, take consideration to give bias voltage to NR-IN terminal by resistor or so on because internal of NR-IN terminal hsa no bias resistor.

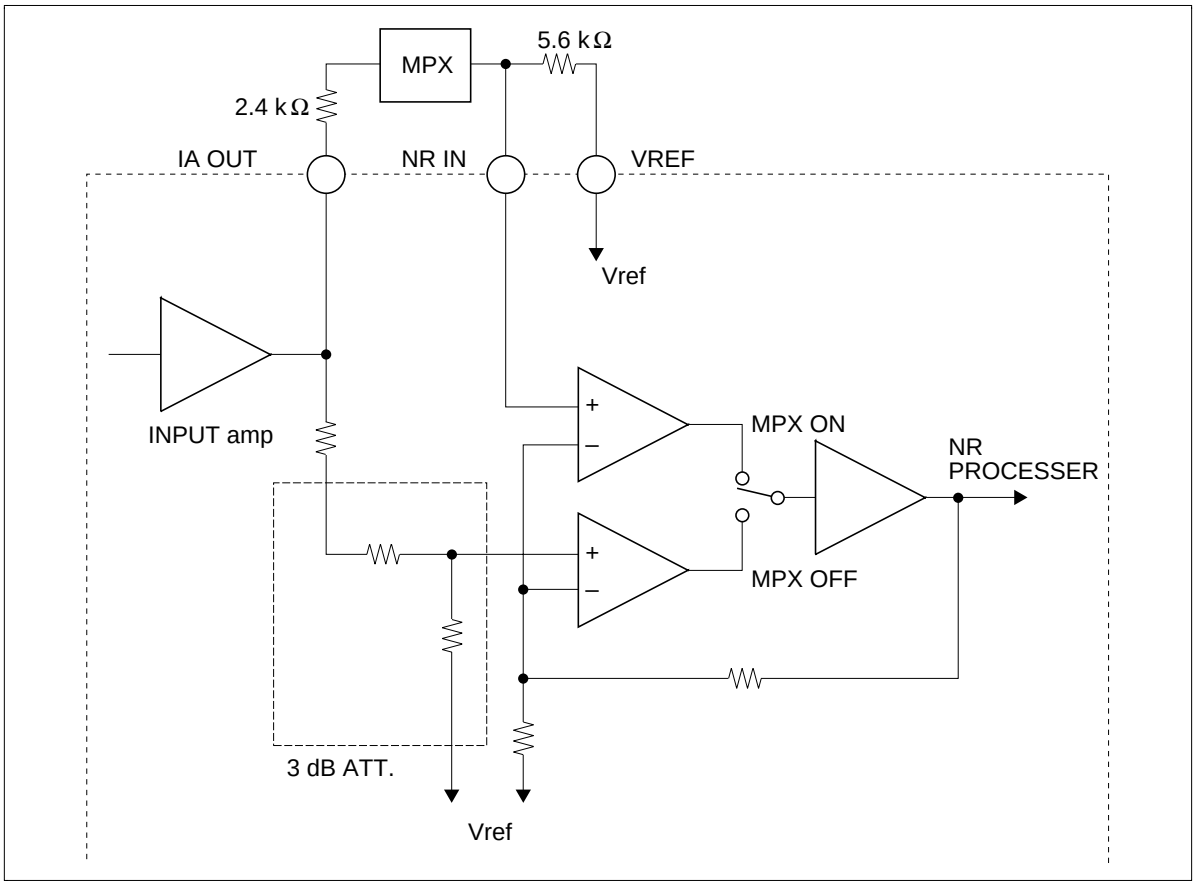


Figure 5 MPX ON/OFF Switch Block Diagram

Application as for the Dubbing Cassette Deck

HA12155NT/HA12157NT series has unprocessor signal from recording out terminals during plyaback mode. So, it is simply applied for dubbing cassette decks.

And HA12155NT/HA12157NT has three input terminal. So, it is applicable to switch the signal from PB-EQ as shown below.

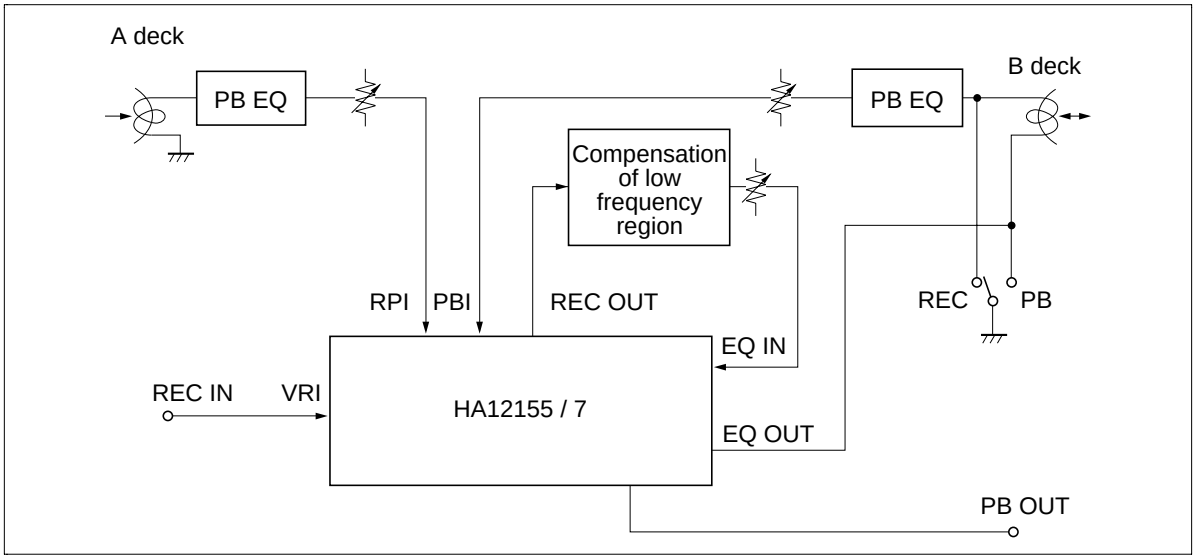


Figure 6 Application for Dubbing Deck

Injector Current

HA12155NT/HA12157NT has logic circuit which is fabricated by I^2L into IC. To operate this circuit, it is required enough injector current. Injector current goes into from the INJ pin (pin 10) and external resistor is required to connect to this pin for adequate current. The value of external resistor is obtained by using following equations. And put them with ±10% tolerance value which is calculated. V_{INJ} can allow to connect to V_{CC} shown below. Under the condition of high temperature, the mis-operation of logic is caused by large injector current. Also, under the condition of low temperature, the stop of logic is caused by small injector current. Therefore, pay attention to have good stability of V_{INJ}.

$$R_{INJ} = \frac{V_{INJ} - 0.7}{3.6} \quad [k\Omega] \text{ ---- Single supply}$$

$$R_{INJ} = \frac{V_{INJ} + V_{EE} - 0.7}{3.6} \quad [k\Omega] \text{ ---- Split supply}$$

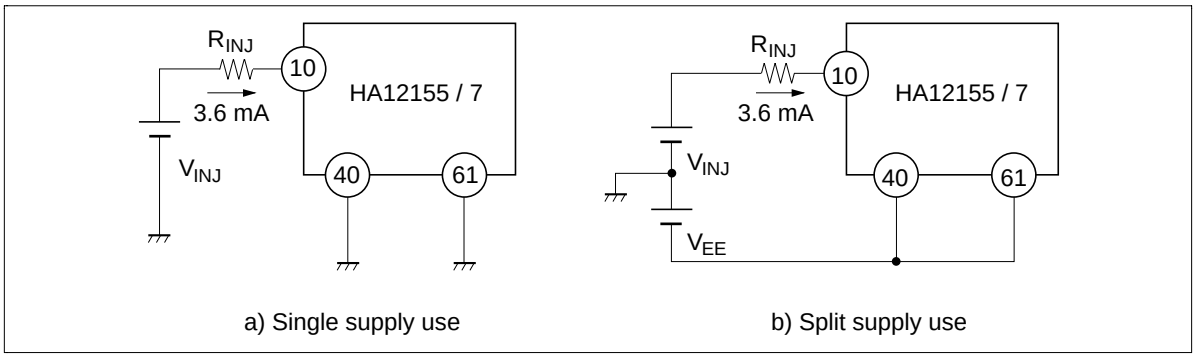


Figure 7 Injector Current Application

Gain Control of Electronic Volume

HA12155NT/HA12157NT is designed in order to change the gain by 6 bit DAC fabricated into IC. To reduce the click noise when changing volume gain instantaneously, required to connect the capacitor (CR time constant) to CNT pin (pin 6,59). These terminals are also be used as output pin of DAC. Therefore, by forcing voltage or current to these terminals, it is applicable to control volume gain directly. But, voltage forced to these terminals must be from $V_{CC}/2$ –2 V to $V_{CC}/2$ (for split supply use, –2 V to 0 V) in this case. In case of forcing the current these pins, voltage must be the value mentioned above even it is ±20% distributed of internal resistor (5.2 kΩ) of CNT pin. And, these case, change of a gain depending on a temperature gets large.

The Tolerances of External Components for Dolby NR-Block

For adequate Dolby NR tracking response, take external components shown below.

For smooth capacitors of C13, C14, C25 and C26, please employ a few object of the leak, though you can be useful for an electrolytic capacitor.

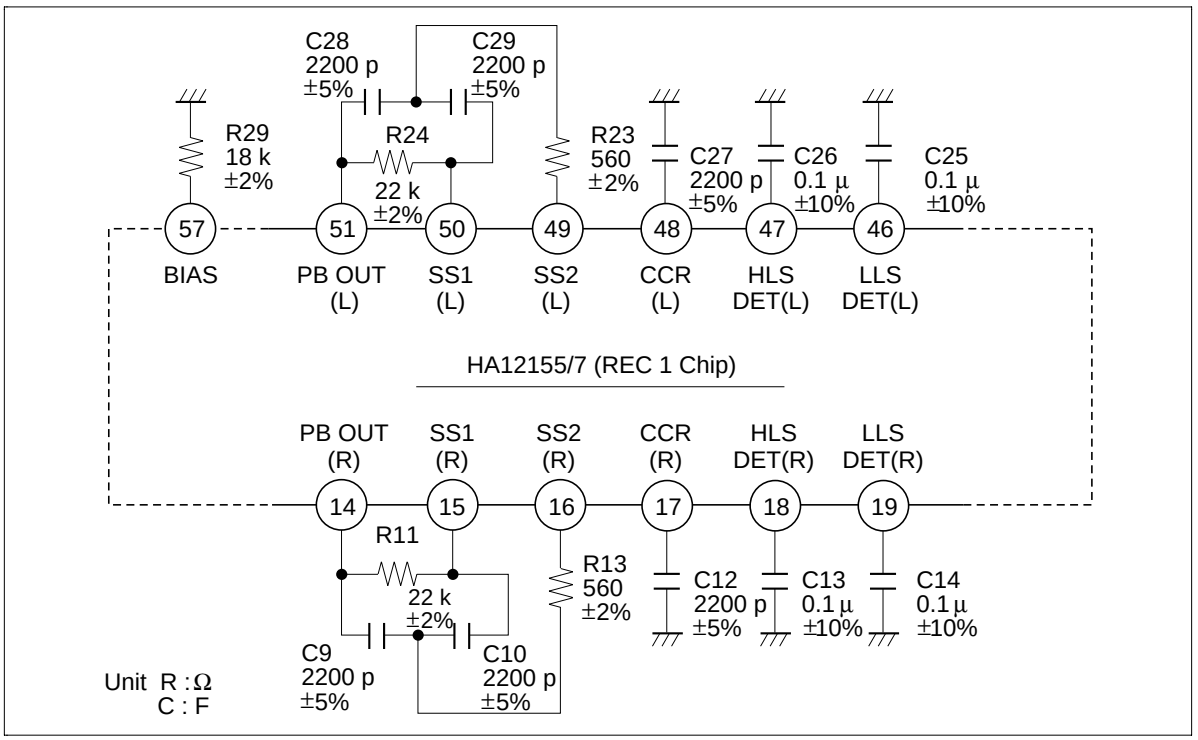


Figure 8 Tolerances of External Components

Level Meter

The coupling capacitor of LMIN pin (21 pin and 44 pin).

For these capacitors please employ a small object of the leak.

The Application of Equalizer Frequency Response

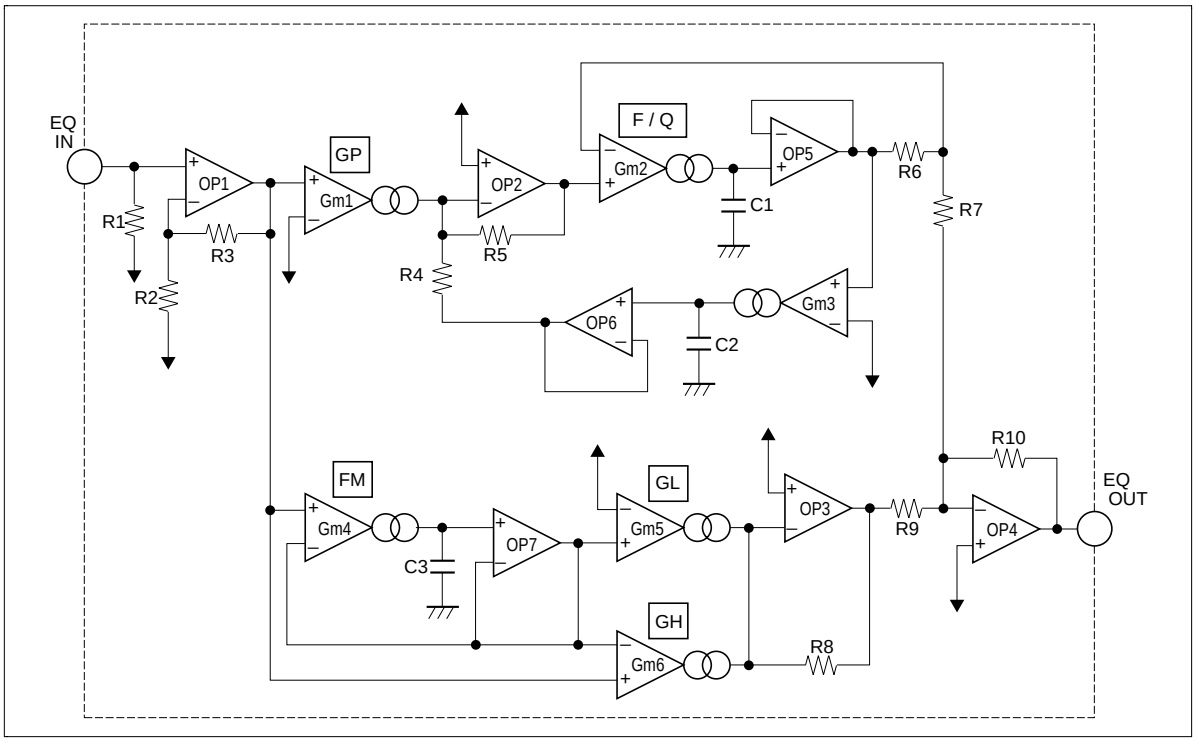


Figure 9 REC Equalizer Block Diagram

Transfer Function:

$$\frac{Vout}{Vin} = \frac{R_2 + R_3}{R_2}\left(Gm5\frac{R_8 \cdot R_{10}}{R_9}\frac{1+\frac{C3}{Gm4}\frac{Gm6}{Gm5}S}{1+\frac{C3}{Gm4}S} + Gm1\frac{R_4 \cdot R_{10}}{R_6+R_7}\frac{\frac{C2}{Gm3}S}{1+\frac{R_4}{R_5}\frac{R7}{R_6+R_7}\frac{C2}{Gm3}S+\frac{R_4}{R_5}\frac{C1}{Gm2}\frac{C2}{Gm3}S^2} \right)$$

$$= \frac{4.16}{R_{REF}}\left(R_{GL}\frac{1+6.67\times10^{-10}\frac{R_{FM}\cdot R_{GH}}{R_{GL}}\cdot S}{1+6.67\times10^{-10}R_{FM}\cdot S} + RGP\frac{3.0\times10^{-10}\cdot R_{FQ}\cdot S}{1+4.5\times10^{-11}\cdot R_{FQ}\cdot S+2.5\times10^{-20}\cdot R_{FQ}\cdot R_{F/Q}S^2} \right)$$

*R_{REF}-----25 pin bias resistance

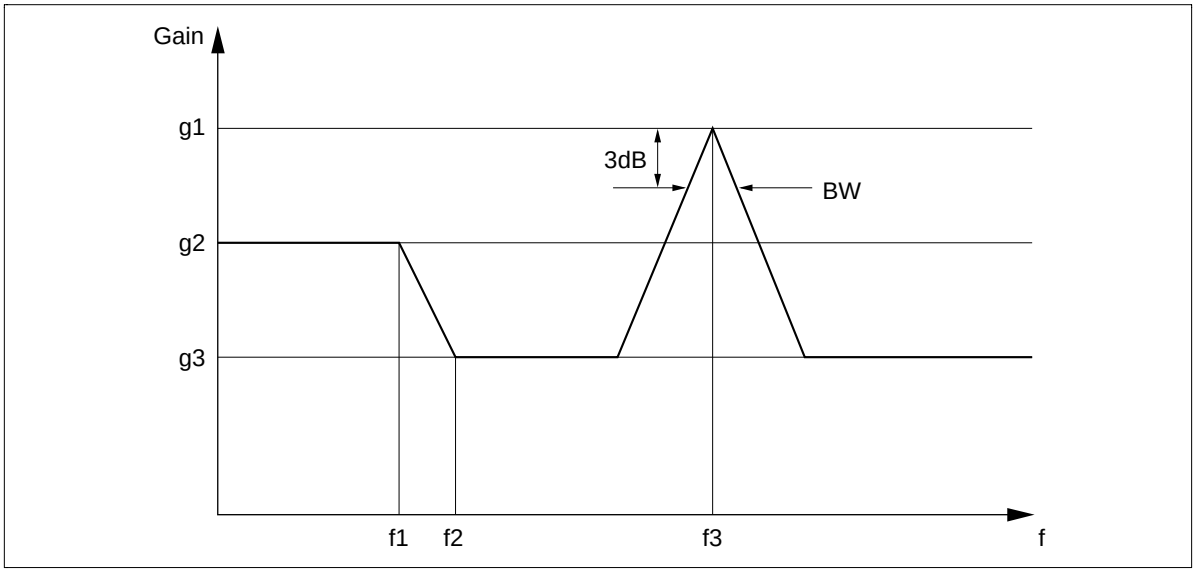


Figure 10 REC Equalizer Frequency Response

$$gl = \frac{4.16}{R_{REF}}\left(6.67 \times R_{GP} + R_{GH}\right)$$

$$g2 = \frac{4.16 \times R_{GL}}{R_{REF}}$$

$$g3 = \frac{4.16 \times R_{GH}}{R_{REF}}$$

$$f1 = \frac{1}{2\pi \times 6.67 \times 10^{-10} \times R_{FM}}$$

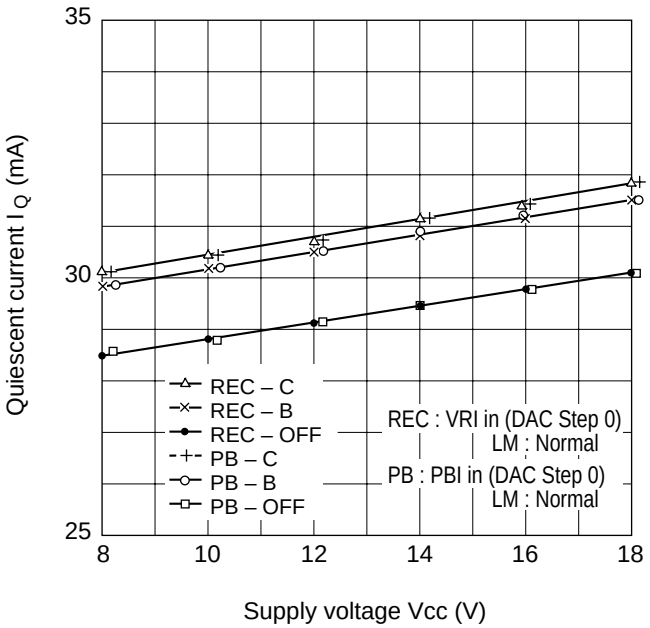
$$f2 = \frac{R_{GL}}{2\pi \times 6.67 \times 10^{-10} \times R_{FM} \times R_{GH}}$$

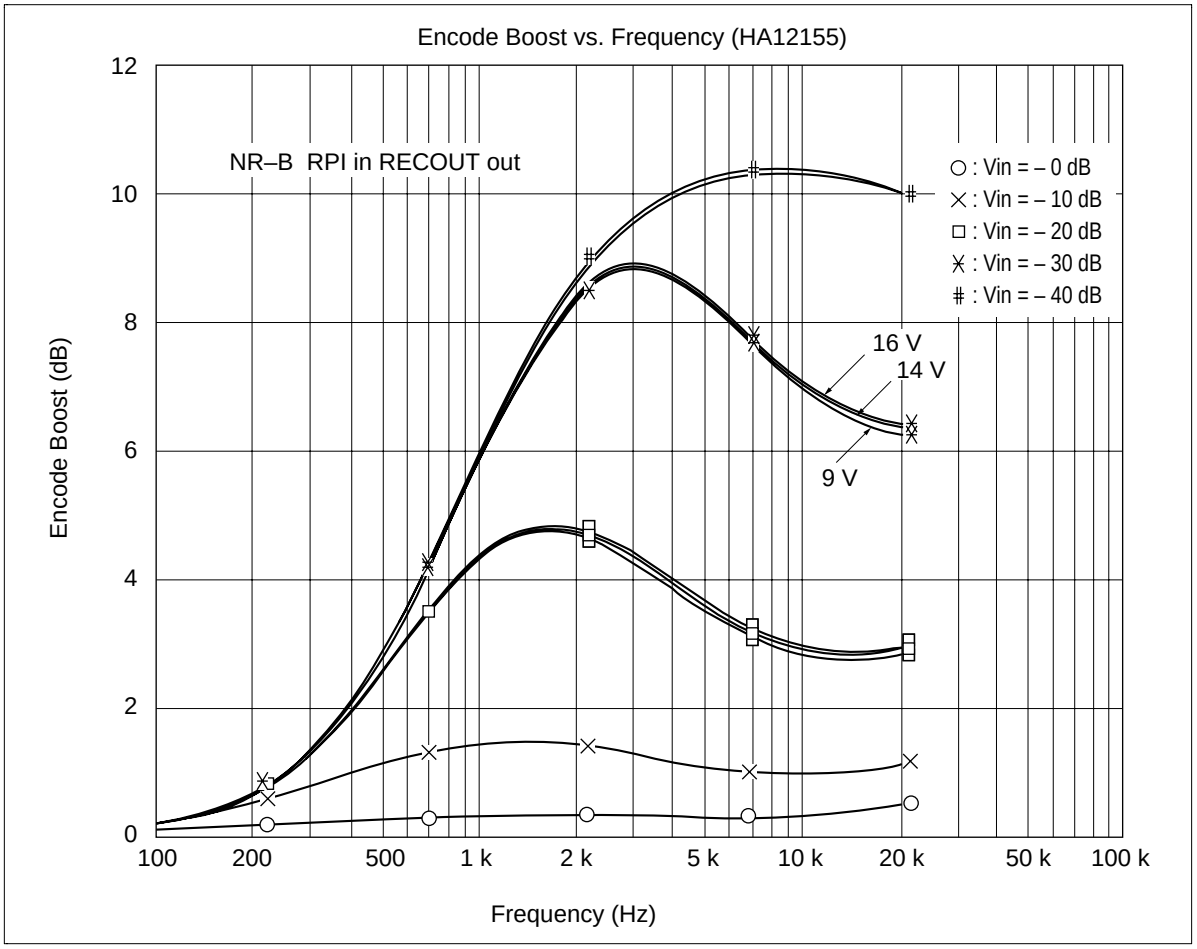
$$f3 = \frac{1}{2\pi} \cdot \frac{0.3}{\sqrt{2.25 \times 10^{-21} \times R_{FQ} \times R_{F/Q}}}$$

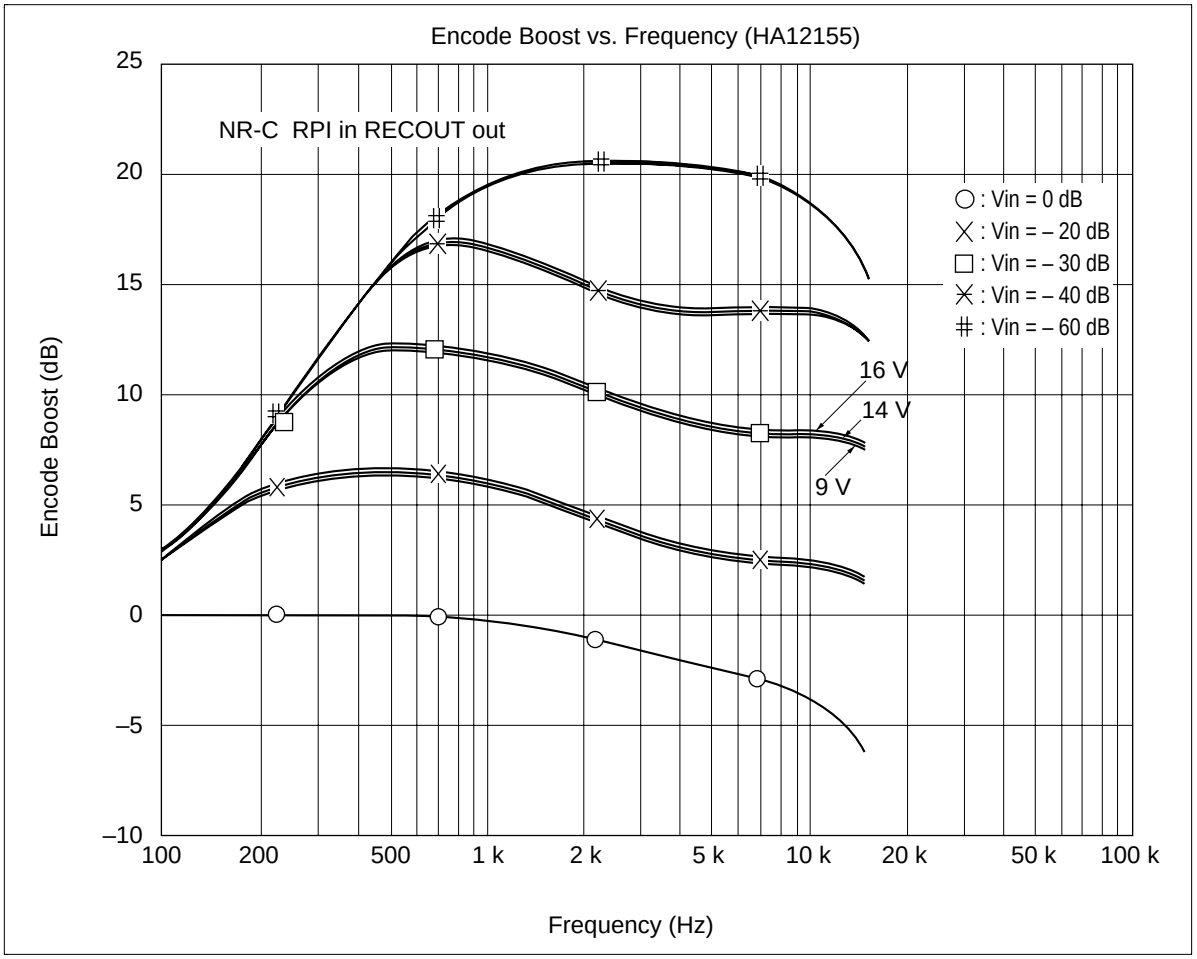
$$BW = \frac{1}{4\pi \times 2.78 \times 10^{-10} \times R_{F/Q}}$$

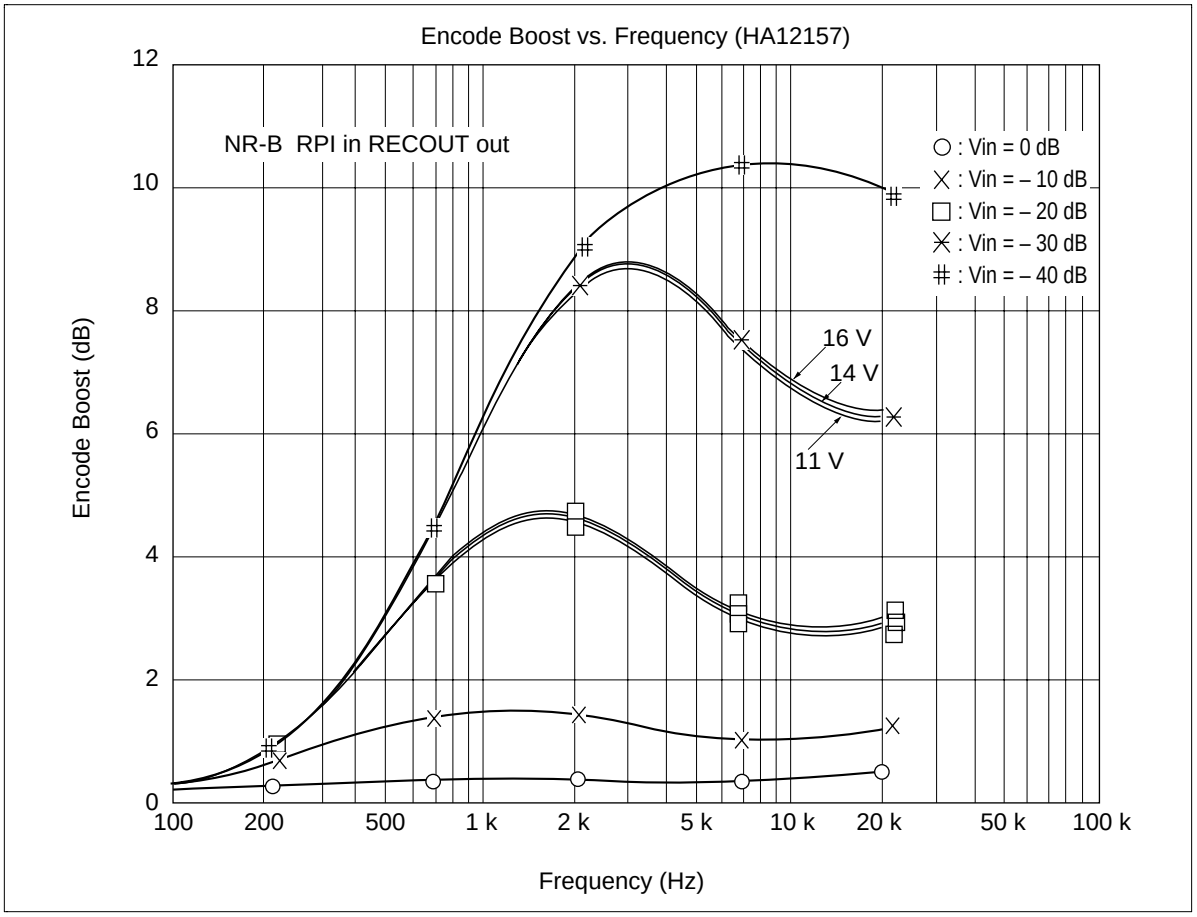
$$Q = \frac{f3}{BW} = 3.51 \times \sqrt{\frac{R_{F/Q}}{R_{F/Q}}}$$

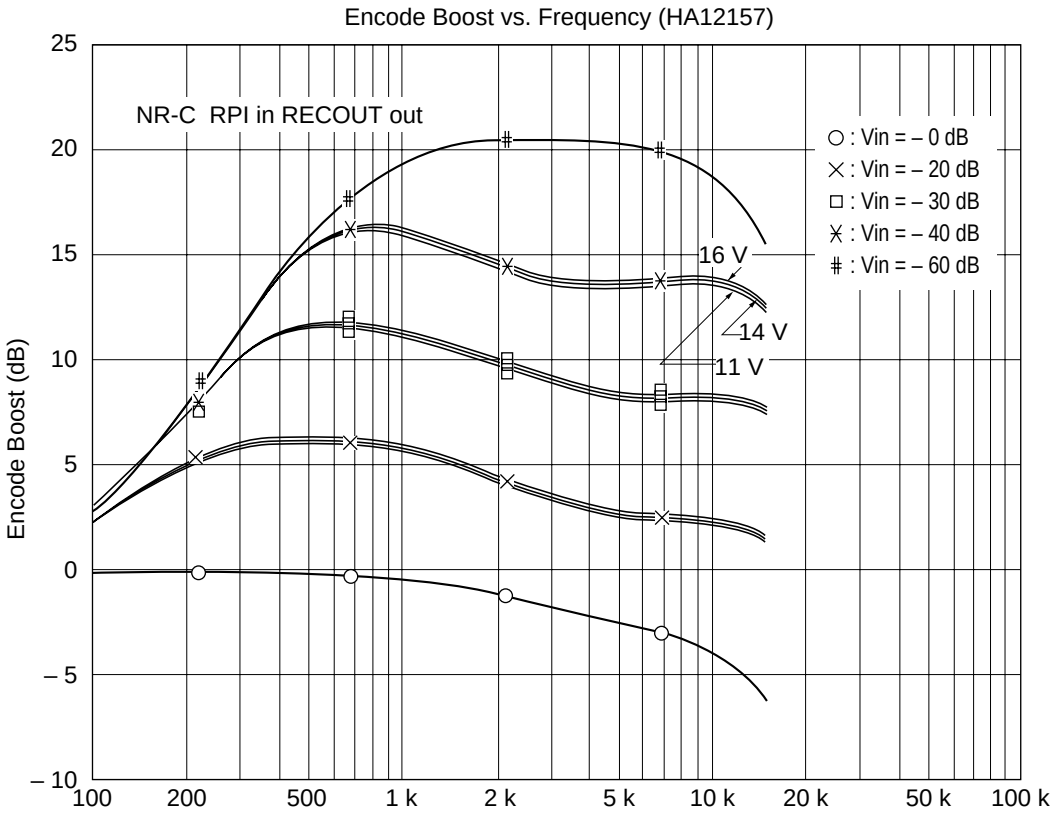
Quiescent Current vs. Supply Voltage

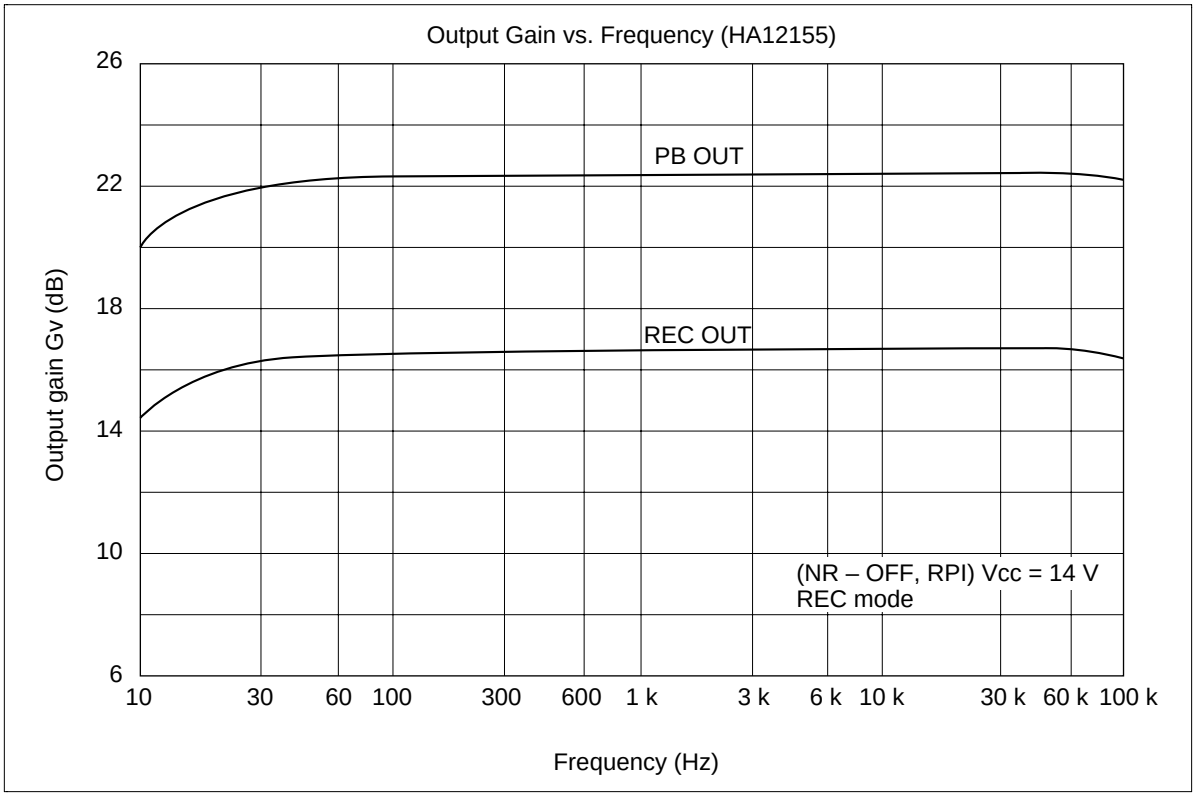


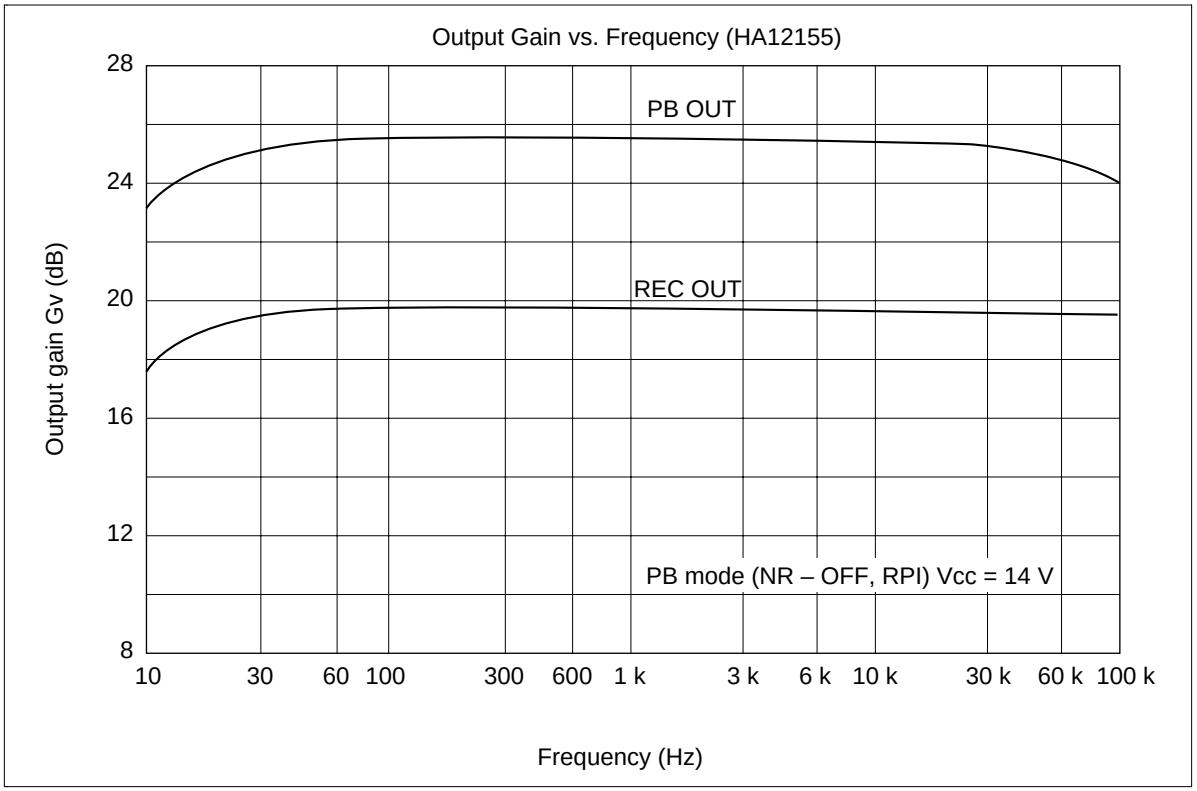

Encode Boost vs. Frequency (HA12155)
NR–B RPI in RECOUT out
○ : Vin = – 0 dB
× : Vin = – 10 dB
□ : Vin = – 20 dB
⁑ : Vin = – 30 dB
: Vin = – 40 dB
16 V
14 V
9 V
Encode Boost (dB)
0
2
4
6
8
10
12
100
200
500
1 k
2 k
5 k
10 k
20 k
50 k
100 k
Frequency (Hz)

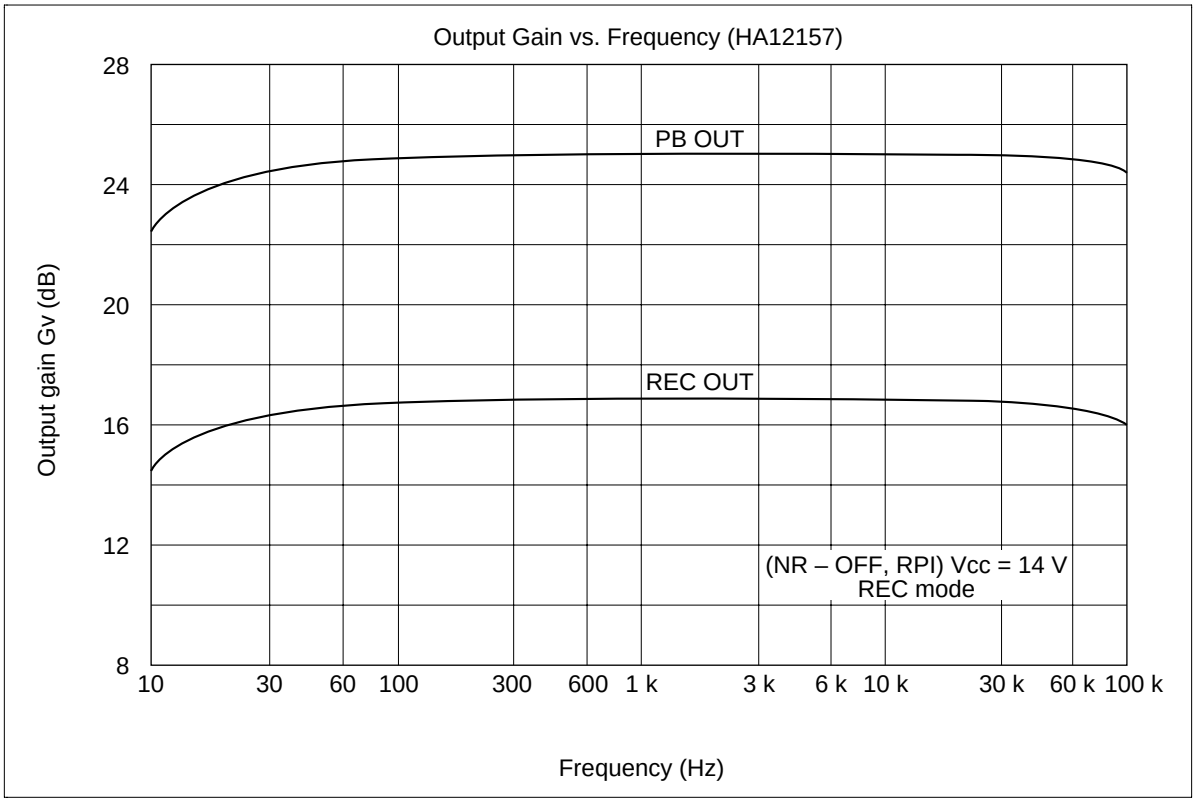

Encode Boost vs. Frequency (HA12155)
NR-C RPI in RECOUT out
○ : Vin = 0 dB
╳ : Vin = – 20 dB
□ : Vin = – 30 dB
✳ : Vin = – 40 dB
: Vin = – 60 dB
16 V
14 V
9 V
Encode Boost (dB)
25
20
15
10
5
0
–5
–10
100
200
500
1 k
2 k
5 k
10 k
20 k
50 k
100 k
Frequency (Hz)

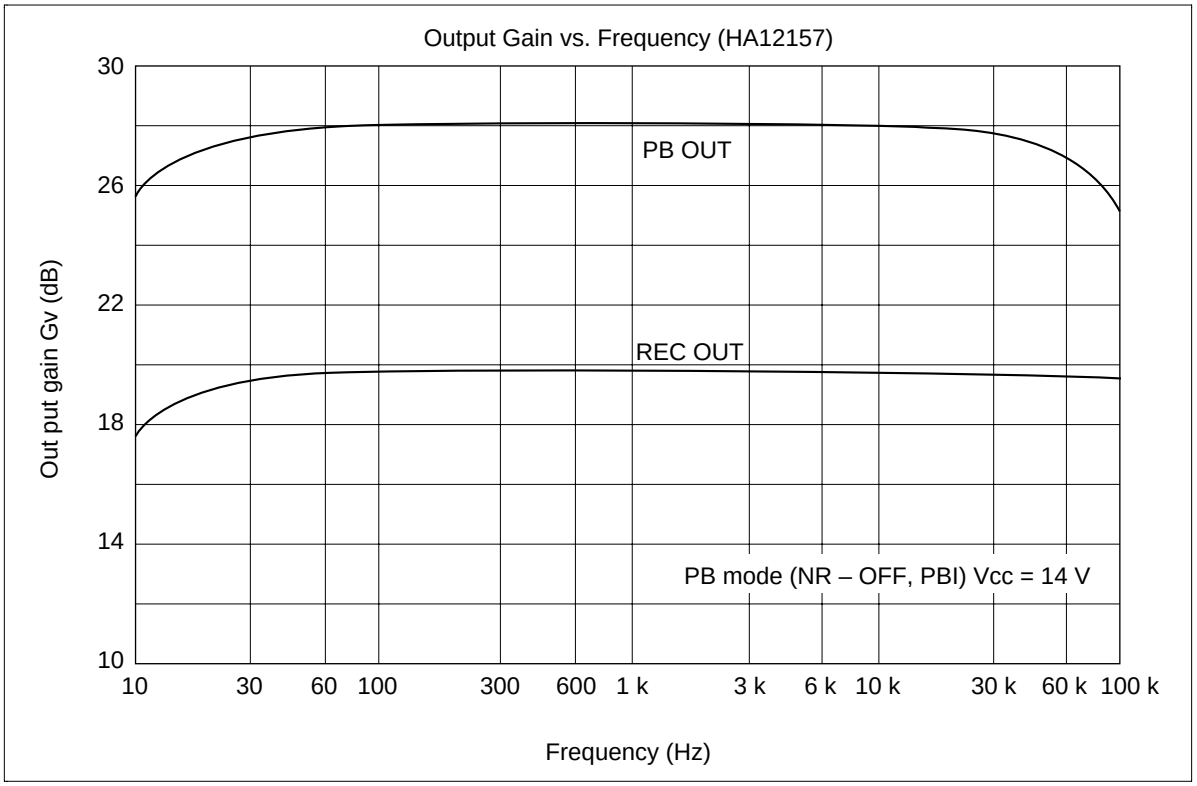

Encode Boost vs. Frequency (HA12157)
NR-B RPI in RECOUT out
○ : Vin = 0 dB
× : Vin = – 10 dB
□ : Vin = – 20 dB
⊠ : Vin = – 30 dB
: Vin = – 40 dB
16 V
14 V
11 V
Encode Boost (dB)
0
2
4
6
8
10
12
100
200
500
1 k
2 k
5 k
10 k
20 k
50 k
100 k
Frequency (Hz)


Encode Boost vs. Frequency (HA12157)
NR-C RPI in RECOUT out
○ : Vin = – 0 dB
× : Vin = – 20 dB
□ : Vin = – 30 dB
⨯ : Vin = – 40 dB
: Vin = – 60 dB
16 V
14 V
11 V
Encode Boost (dB)
25
20
15
10
5
0
– 5
– 10
100
200
500
1 k
2 k
5 k
10 k
20 k
50 k
100 k
Frequency (Hz)

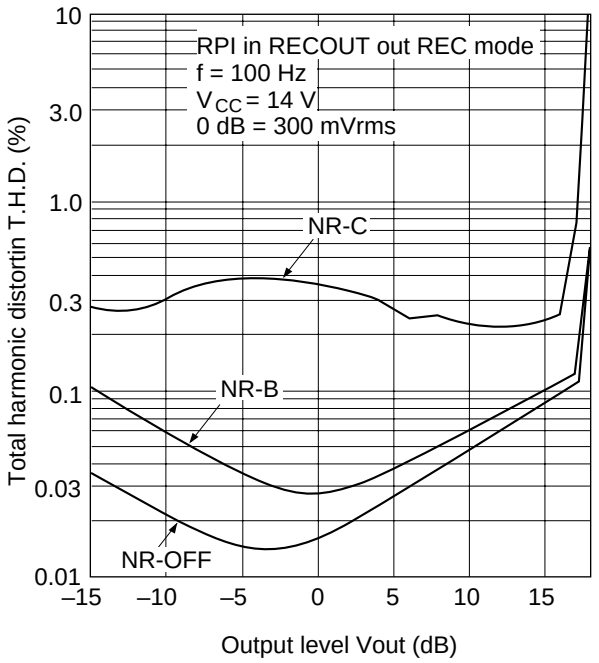

Output Gain vs. Frequency (HA12155)
26
22
18
14
10
6
Output gain Gv (dB)
PB OUT
REC OUT
(NR – OFF, RPI) Vcc = 14 V
REC mode
10
30
60
100
300
600
1 k
3 k
6 k
10 k
30 k
60 k
100 k
Frequency (Hz)


Output Gain vs. Frequency (HA12155)
28
24
20
16
12
8
Output gain Gv (dB)
PB OUT
REC OUT
PB mode (NR – OFF, RPI) Vcc = 14 V
10
30
60
100
300
600
1 k
3 k
6 k
10 k
30 k
60 k
100 k
Frequency (Hz)

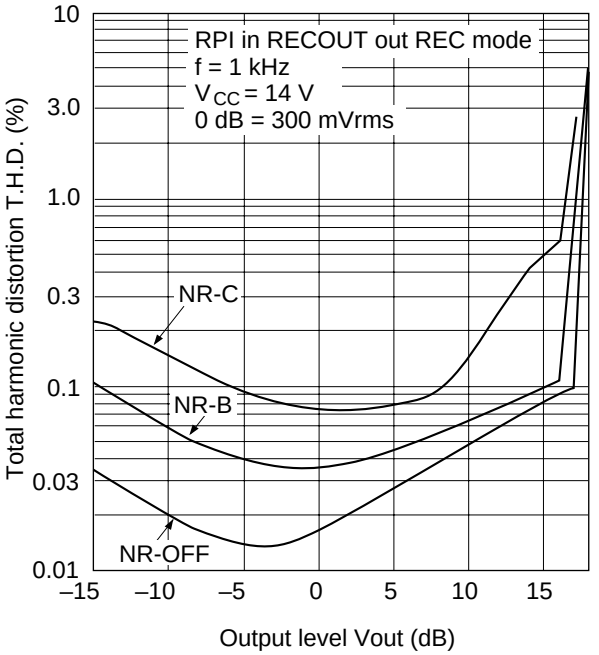

Output Gain vs. Frequency (HA12157)
28
24
20
16
12
8
Output gain Gv (dB)
PB OUT
REC OUT
(NR – OFF, RPI) Vcc = 14 V
REC mode
10
30
60
100
300
600
1 k
3 k
6 k
10 k
30 k
60 k
100 k
Frequency (Hz)


Output Gain vs. Frequency (HA12157)
30
26
22
18
14
10
Out put gain Gv (dB)
PB OUT
REC OUT
PB mode (NR – OFF, PBI) Vcc = 14 V
10
30
60
100
300
600
1 k
3 k
6 k
10 k
30 k
60 k
100 k
Frequency (Hz)

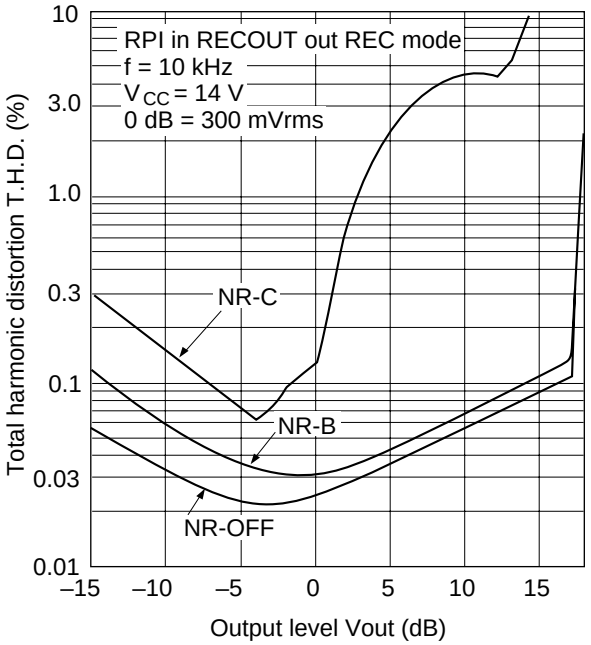
Total Harmonic Distortion vs. Output Level (HA12155)



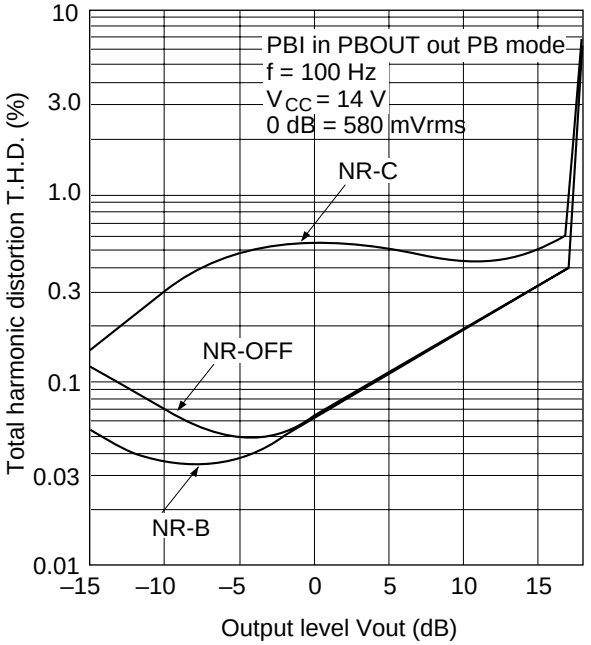
Total Harmonic Distortion vs. Output Level (HA12155)



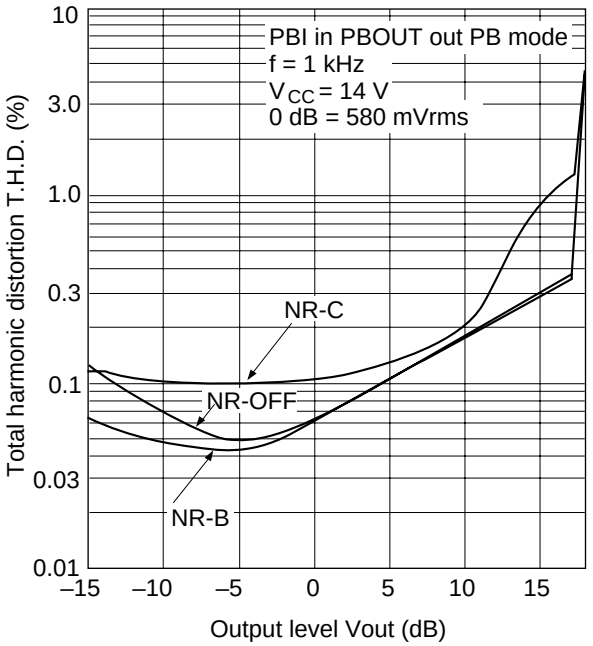
Total Harmonic Distortion vs. Output Level (HA12155)



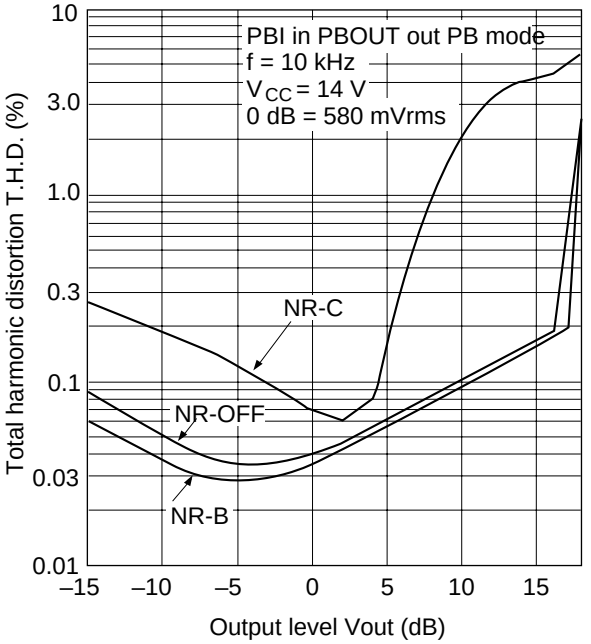
Total Harmonic Distortion vs. Output Level (HA12155)



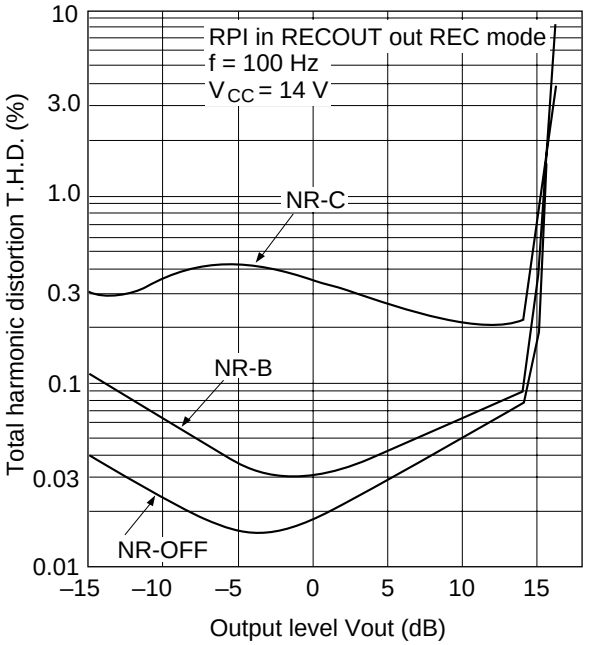
Total Harmonic Distortion vs. Output Level (HA12155)



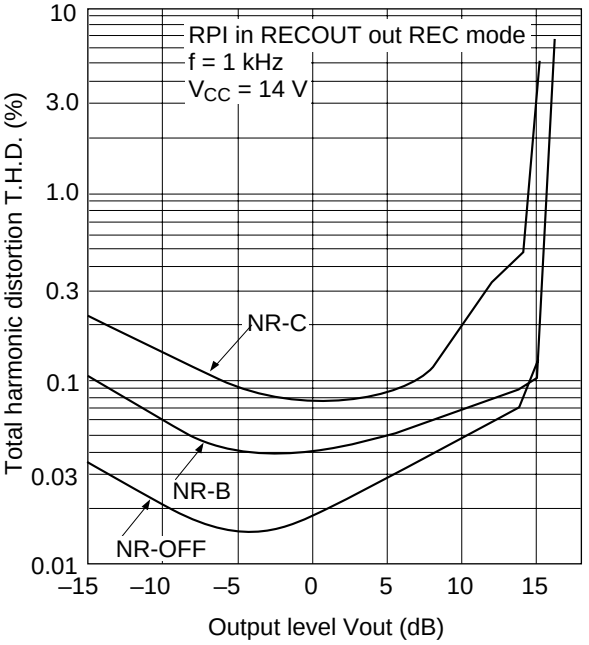
Total Harmonic Distortion vs. Output Level (HA12155)



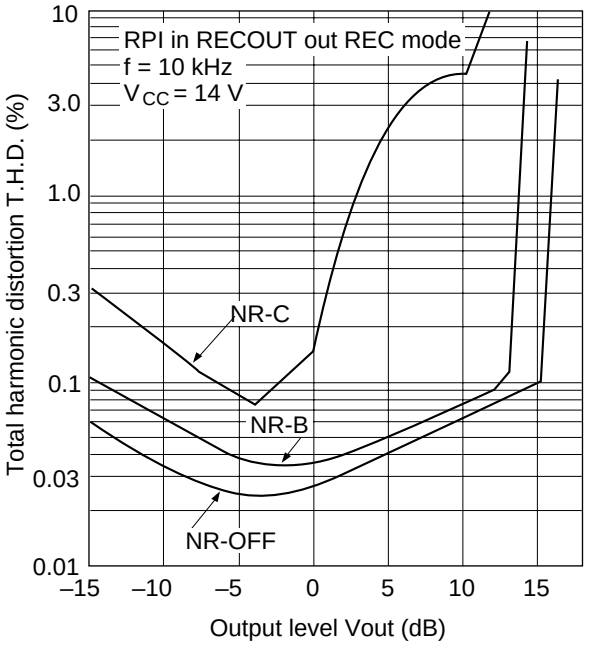
Total Harmonic Distortion vs. Output Level (HA12157)



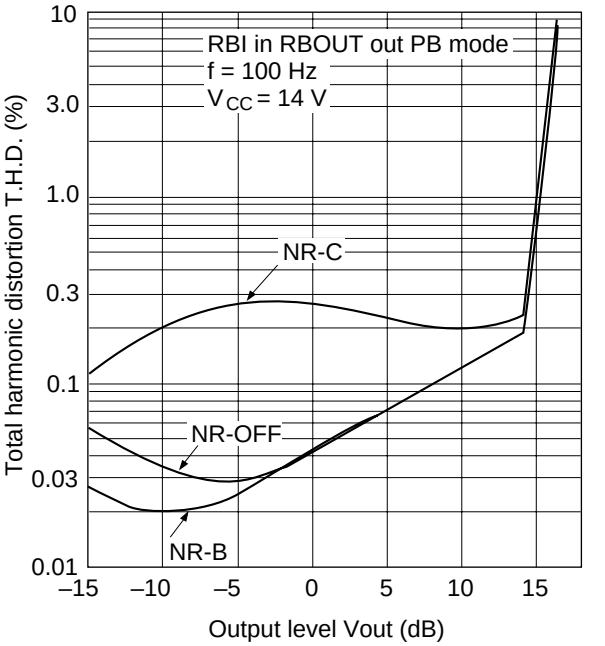
Total Harmonic Distortion vs. Output Level (HA12157)



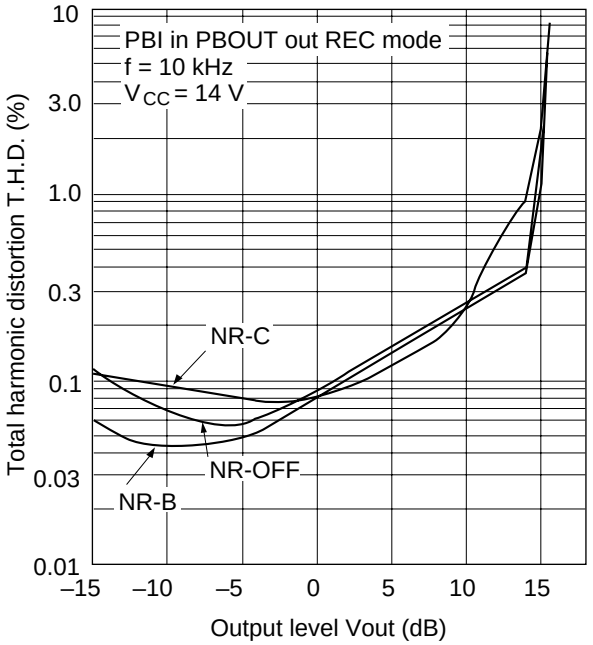
Total Harmonic Distortion vs. Output Level (HA12157)



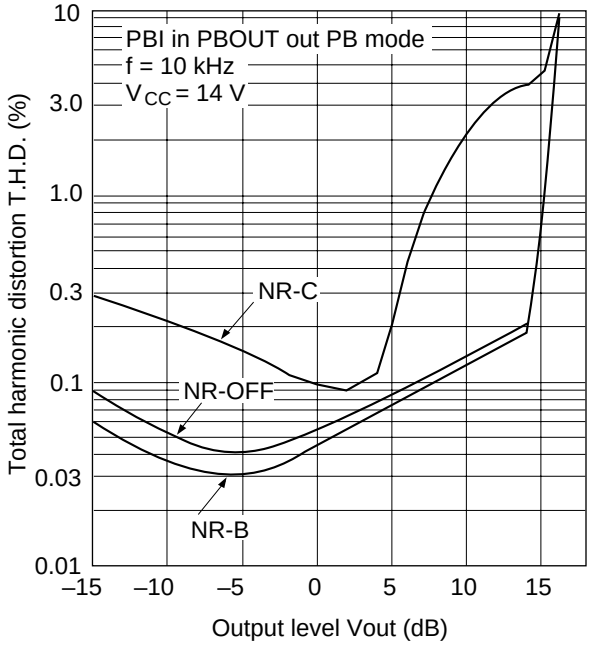
Total Harmonic Distortion vs. Output Level (HA12157)



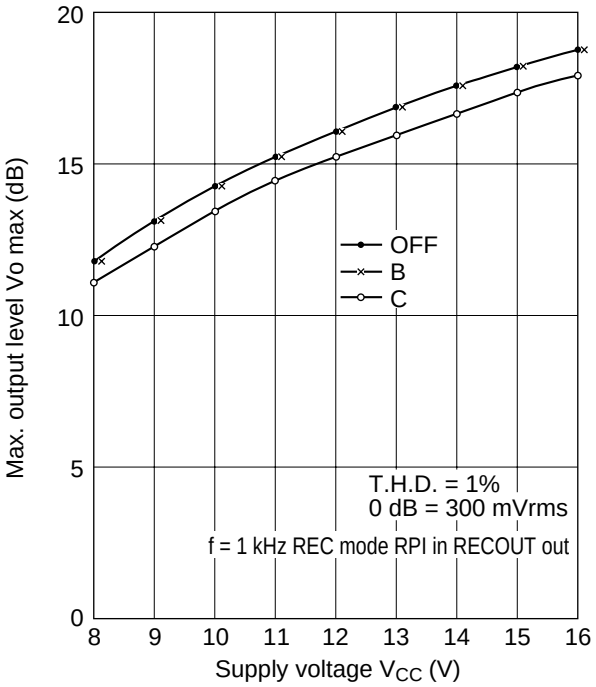
Total Harmonic Distortion vs. Output Level (HA12157)



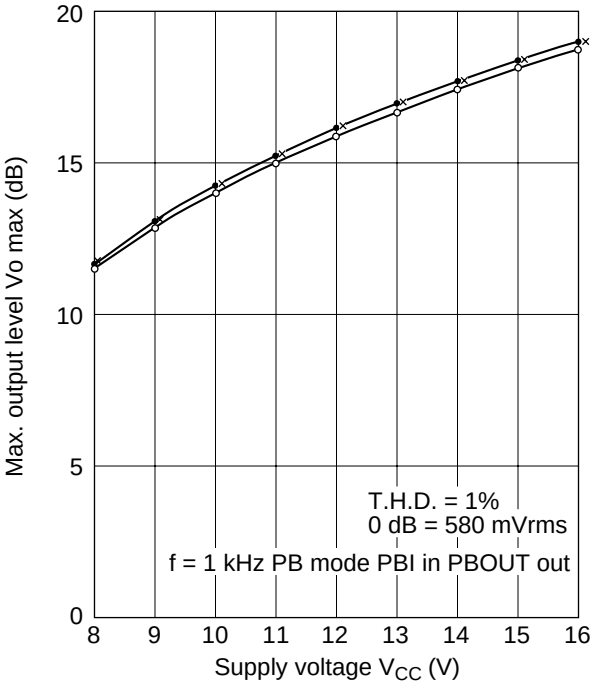
Total Harmonic Distortion vs. Output Level (HA12157)



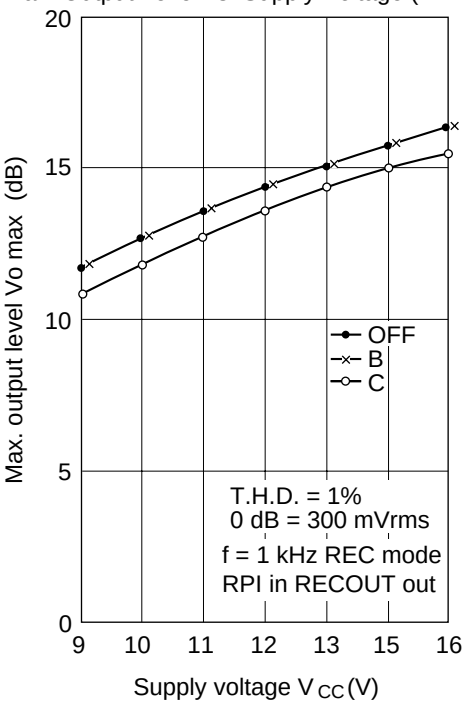
Max. Output Level vs. Supply Voltage (HA12155)



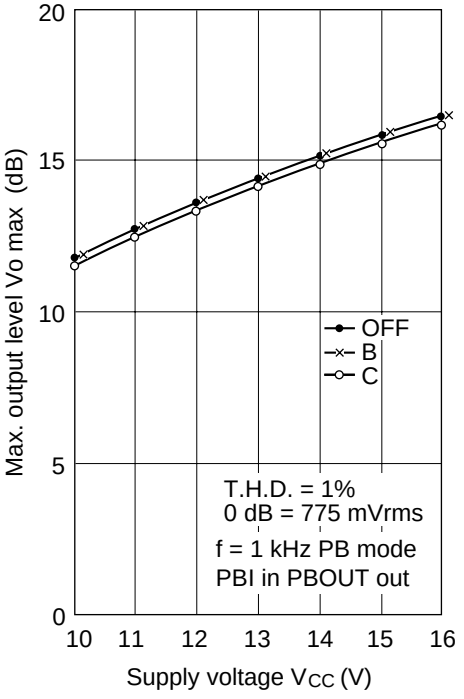
Max. Output Level vs. Supply Voltage (HA12155)



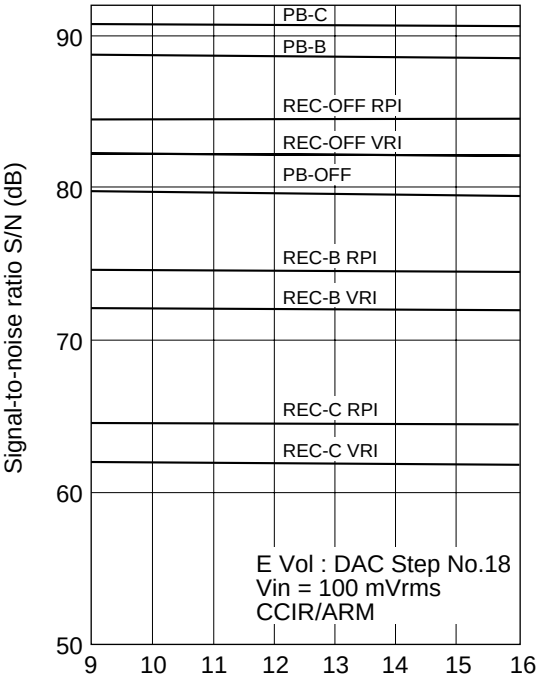
Max. Output Level vs. Supply Voltage (HA12157)



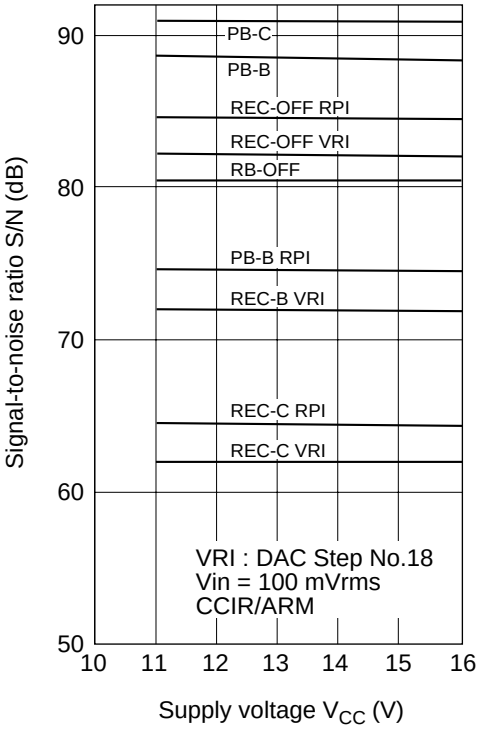
Max. Output Level vs. Supply Voltage (HA12157)



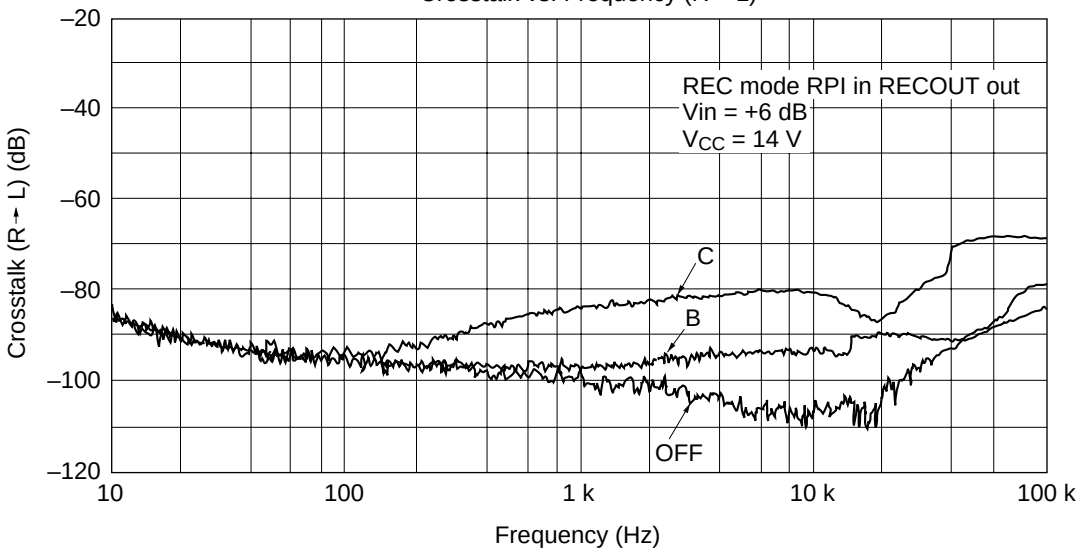
Signal-to-Noise Ratio vs. Supply Voltage (HA12155)

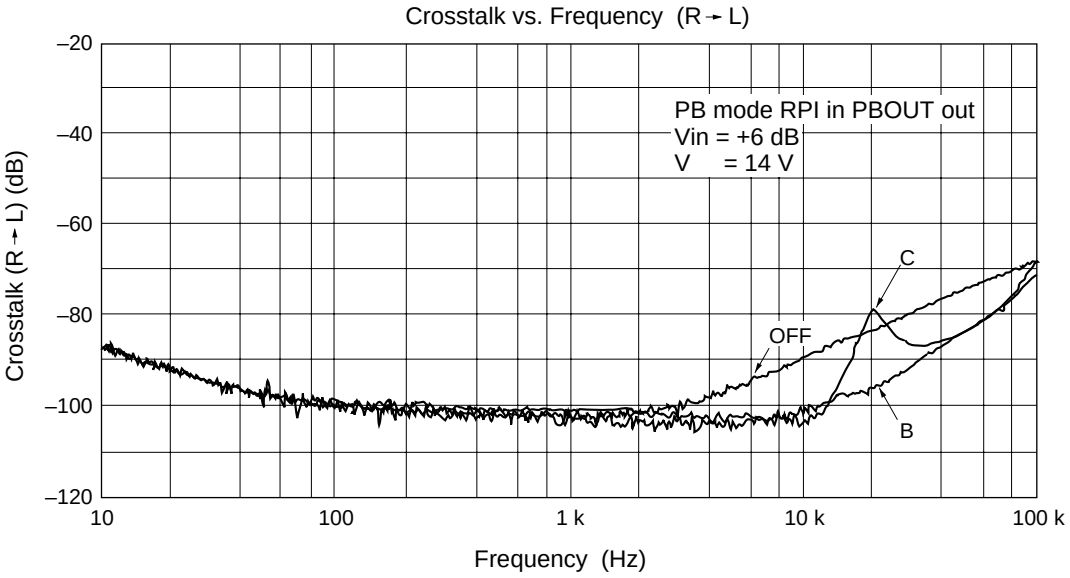


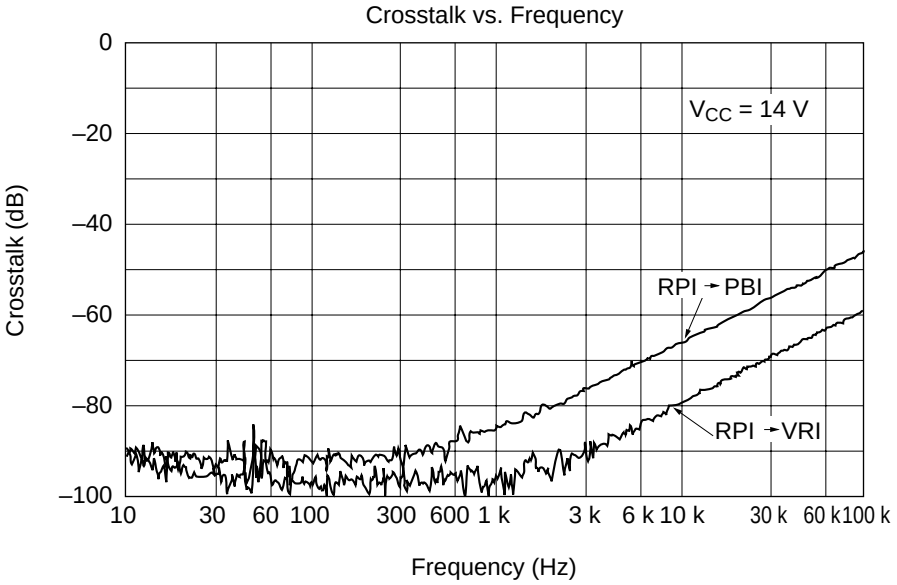
Signal-to-Noise Ratio vs. Supply Voltage (HA12157)

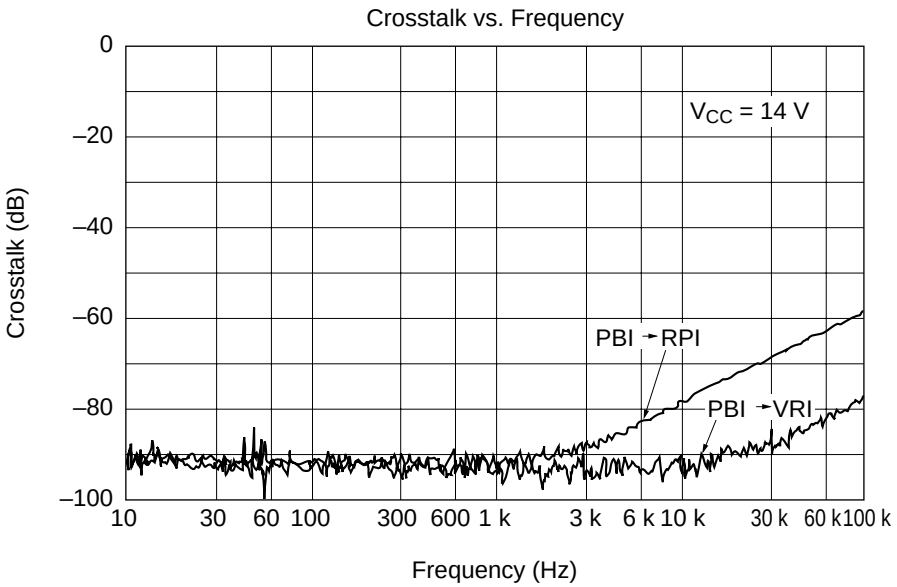


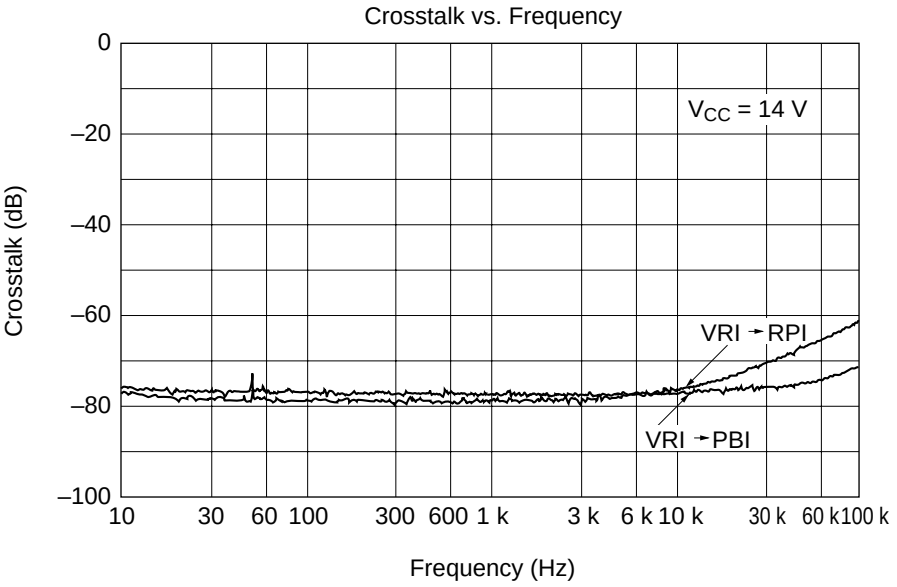
Crosstalk vs. Frequency (R → L)



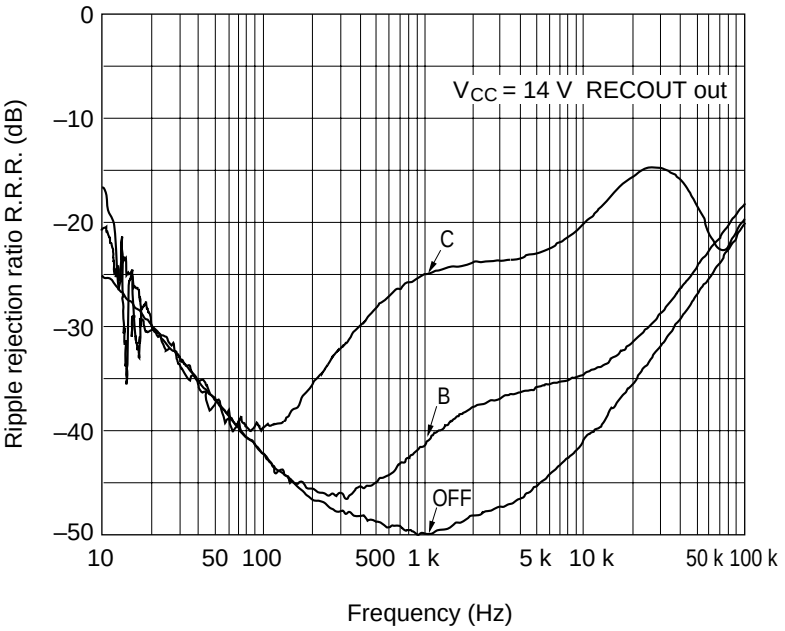

Crosstalk vs. Frequency (R → L)
PB mode RPI in PBOUT out
Vin = +6 dB
V = 14 V
C
OFF
B
Crosstalk (R → L) (dB)
–20
–40
–60
–80
–100
–120
10
100
1 k
10 k
100 k
Frequency (Hz)


Crosstalk vs. Frequency
V_{CC} = 14 V
RPI → PBI
RPI → VRI
Crosstalk (dB)
0
–20
–40
–60
–80
–100
10
30
60
100
300
600
1 k
3 k
6 k
10 k
30 k
60 k
100 k
Frequency (Hz)

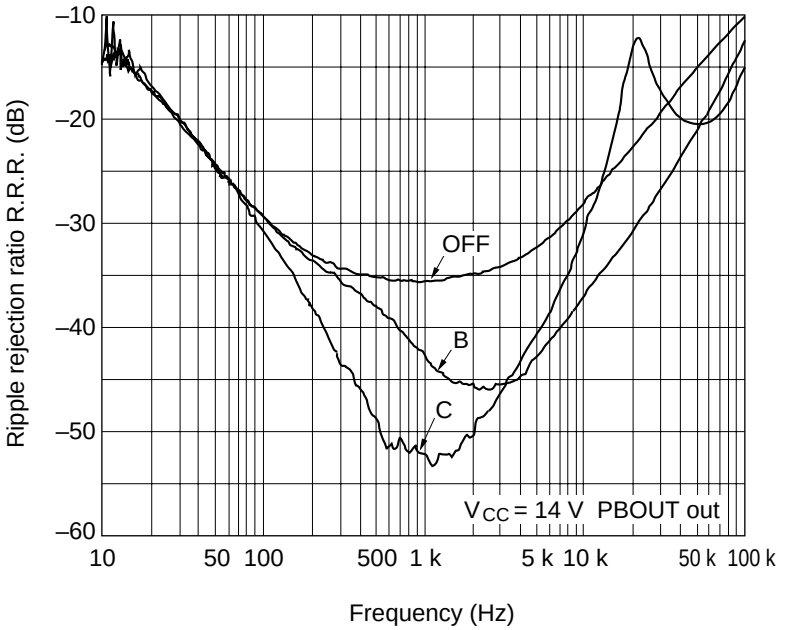

Crosstalk vs. Frequency
0
–20
–40
–60
–80
–100
Crosstalk (dB)
V_{CC} = 14 V
PBI → RPI
PBI → VRI
10
30
60
100
300
600
1 k
3 k
6 k
10 k
30 k
60 k
100 k
Frequency (Hz)

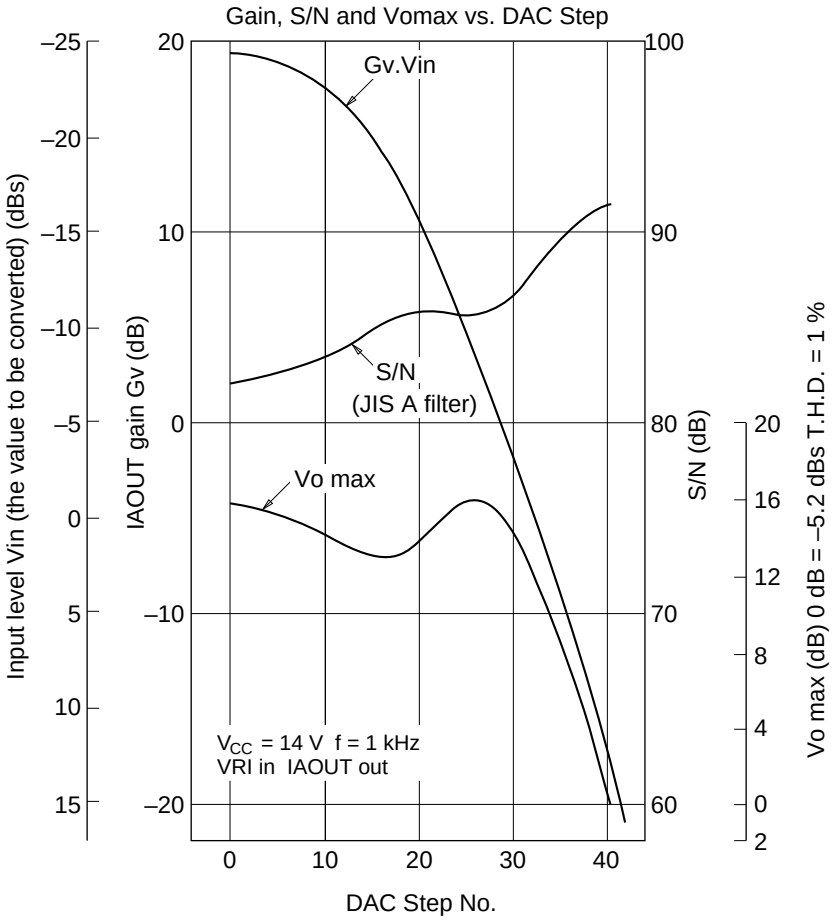

Crosstalk vs. Frequency
0
–20
–40
–60
–80
–100
Crosstalk (dB)
V_{CC} = 14 V
VRI → RPI
VRI → PBI
10
30
60
100
300
600
1 k
3 k
6 k
10 k
30 k
60 k
100 k
Frequency (Hz)

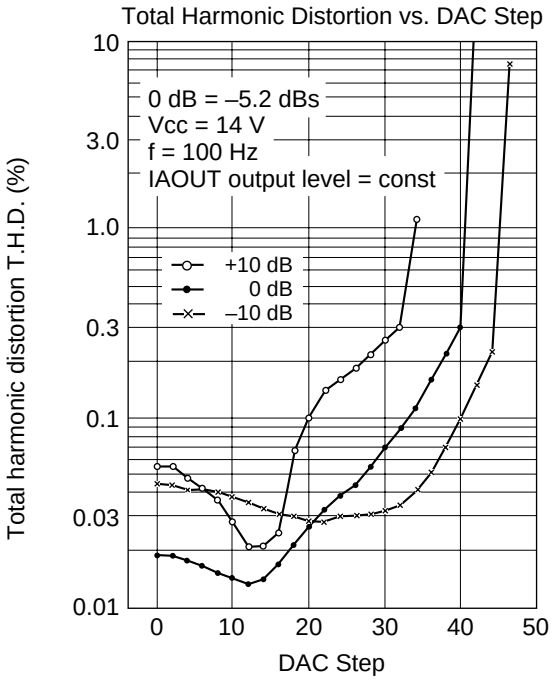
Ripple Rejection Ratio vs. Frequency (REC mode)

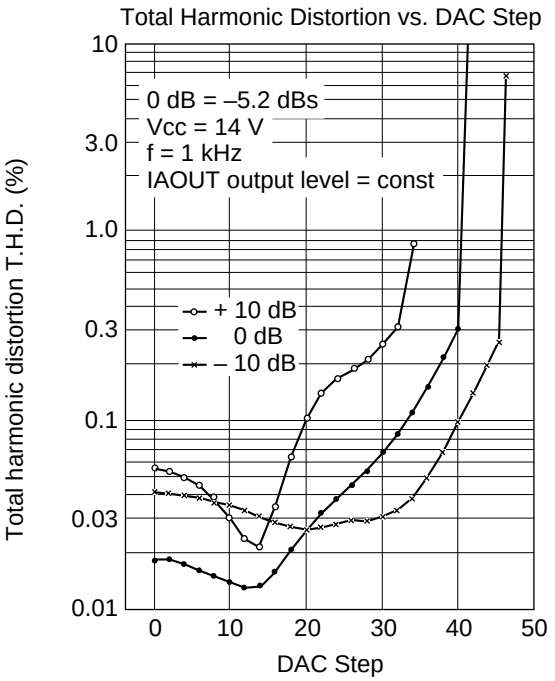


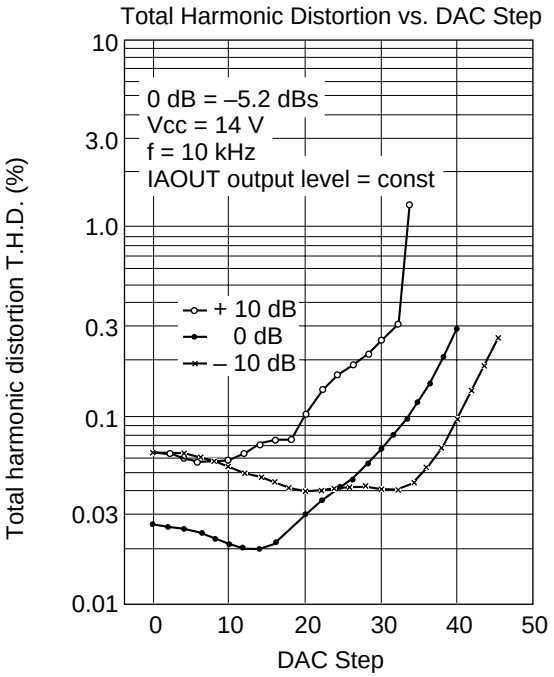
Ripple Rejection Ratio vs. Frequency (PB mode)

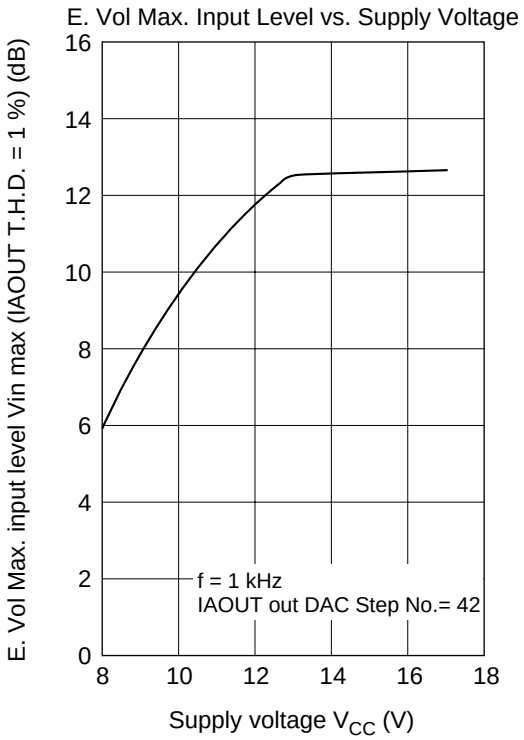



Gain, S/N and Vomax vs. DAC Step
Gv.Vin
S/N
(JIS A filter)
Vo max
V_{CC} = 14 V f = 1 kHz
VRI in IAOUT out
Input level Vin (the value to be converted) (dBs)
IAOUT gain Gv (dB)
S/N (dB)
Vo max (dB) 0 dB = –5.2 dBs T.H.D. = 1 %
DAC Step No.
–25
–20
–15
–10
–5
0
5
10
15
20
10
0
–10
–20
100
90
80
70
60
20
16
12
8
4
0
2
0
10
20
30
40

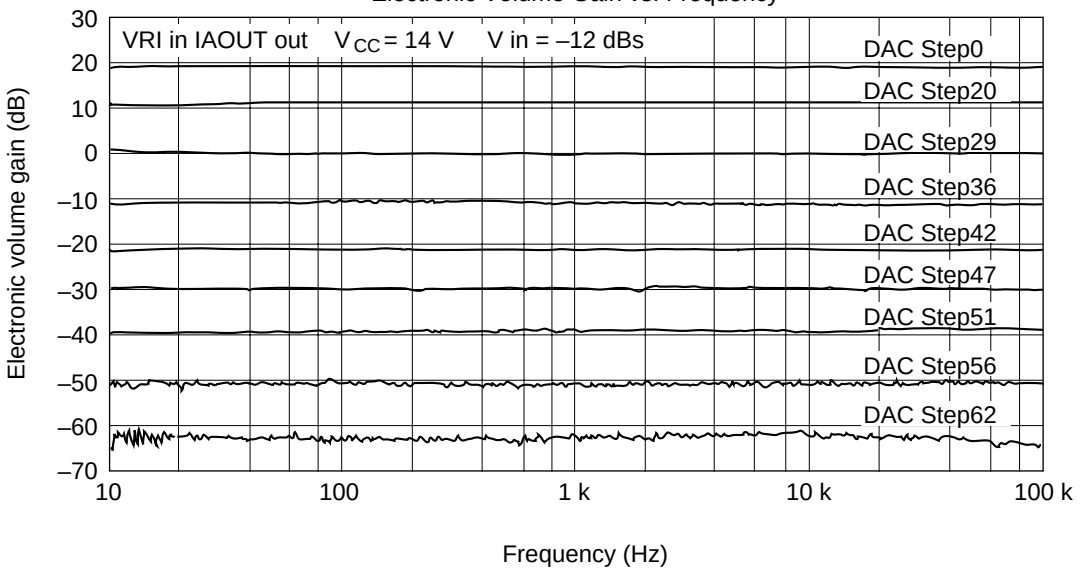

Total Harmonic Distortion vs. DAC Step
0 dB = –5.2 dBs
Vcc = 14 V
f = 100 Hz
IAOUT output level = const
+10 dB
0 dB
–10 dB
Total harmonic distortion T.H.D. (%)
10
3.0
1.0
0.3
0.1
0.03
0.01
0
10
20
30
40
50
DAC Step


Total Harmonic Distortion vs. DAC Step
0 dB = –5.2 dBs
Vcc = 14 V
f = 1 kHz
IAOUT output level = const
+ 10 dB
0 dB
– 10 dB
Total harmonic distortion T.H.D. (%)
10
3.0
1.0
0.3
0.1
0.03
0.01
0
10
20
30
40
50
DAC Step

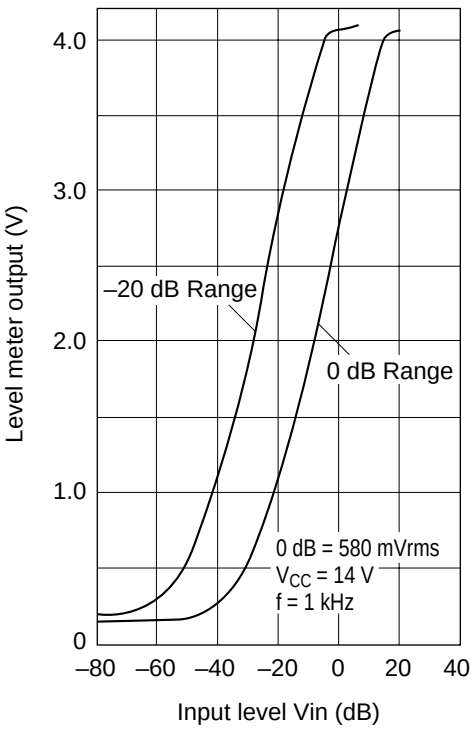

Total Harmonic Distortion vs. DAC Step
10
3.0
1.0
0.3
0.1
0.03
0.01
0 dB = –5.2 dBs
Vcc = 14 V
f = 10 kHz
IAOUT output level = const
+ 10 dB
0 dB
– 10 dB
Total harmonic distortion T.H.D. (%)
0
10
20
30
40
50
DAC Step


E. Vol Max. Input Level vs. Supply Voltage
16
14
12
10
8
6
4
2
0
f = 1 kHz
IAOUT out DAC Step No.= 42
E. Vol Max. input level Vin max (IAOUT T.H.D. = 1 %) (dB)
8
10
12
14
16
18
Supply voltage V_{CC} (V)

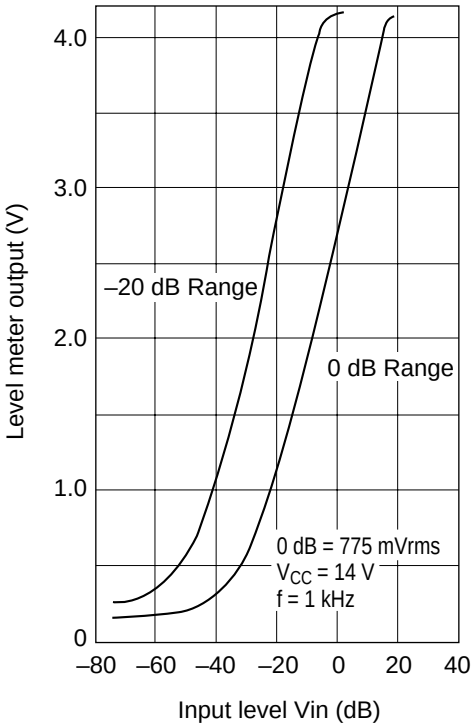
Electronic Volume Gain vs. Frequency



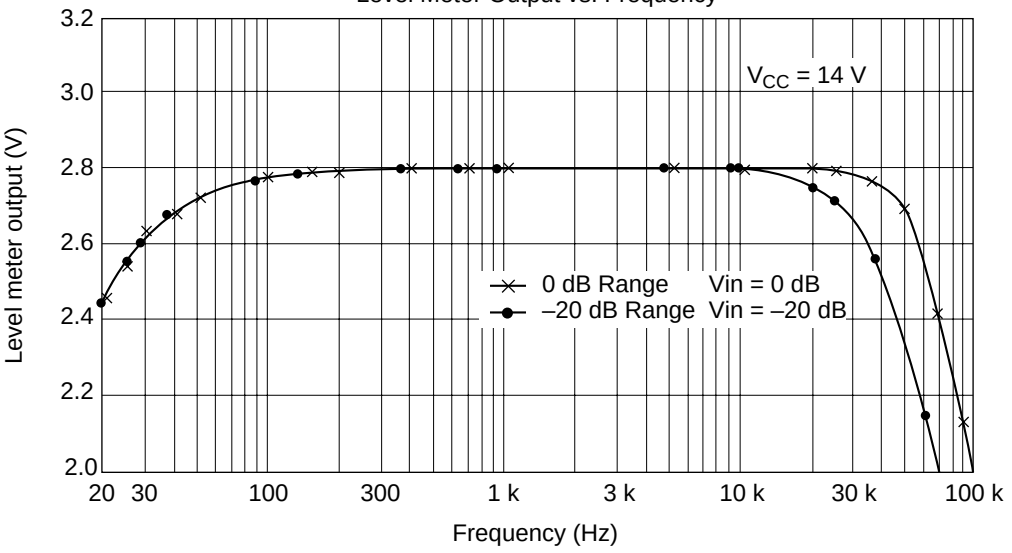
Level Meter Output vs. Input Level (HA12155)



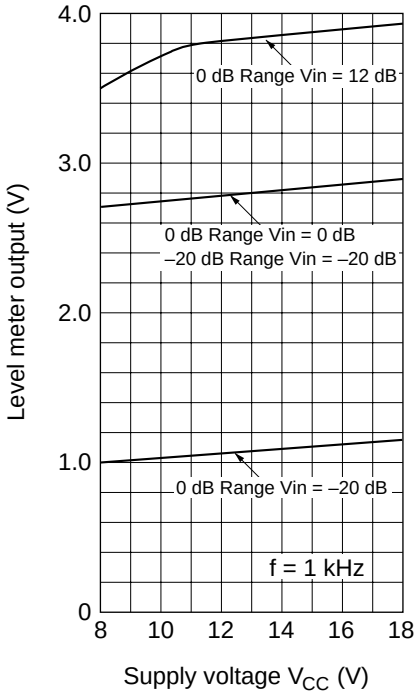
Level Meter Output vs. Input Level (HA12157)



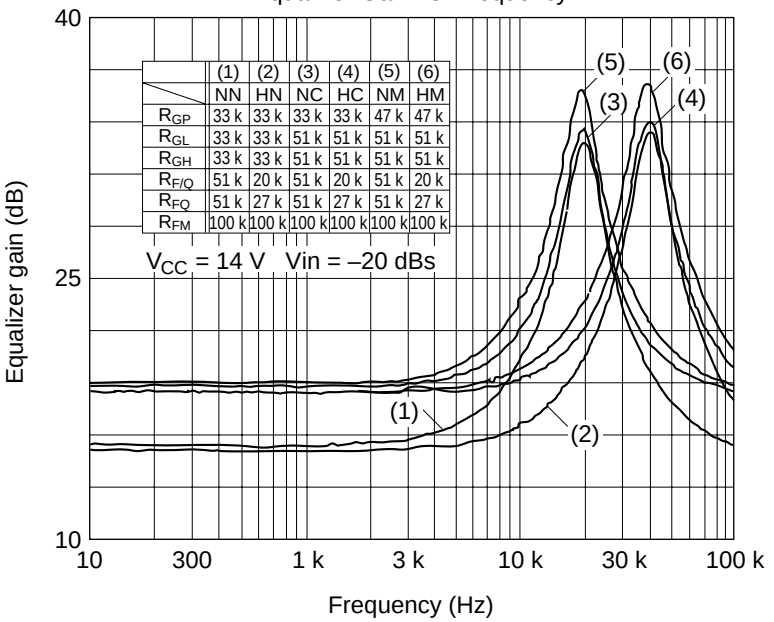
Level Meter Output vs. Frequency



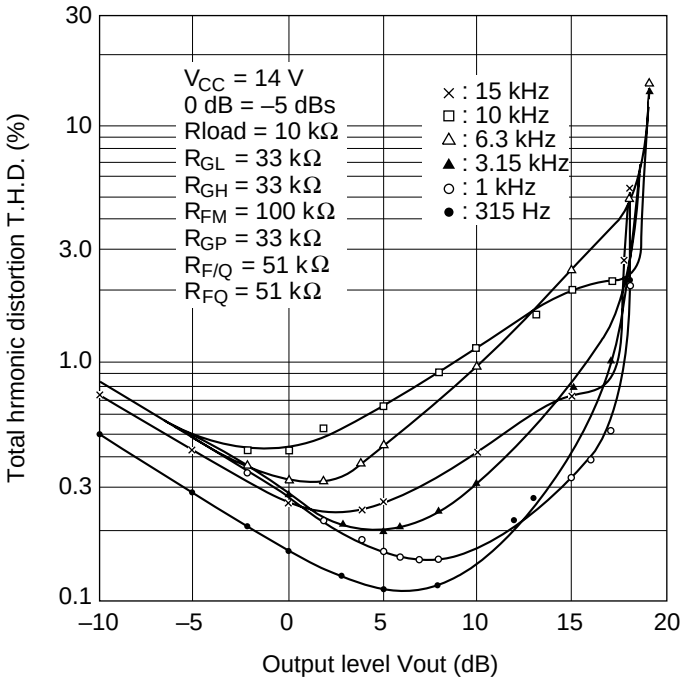
Level Meter Output vs. Supply Voltage



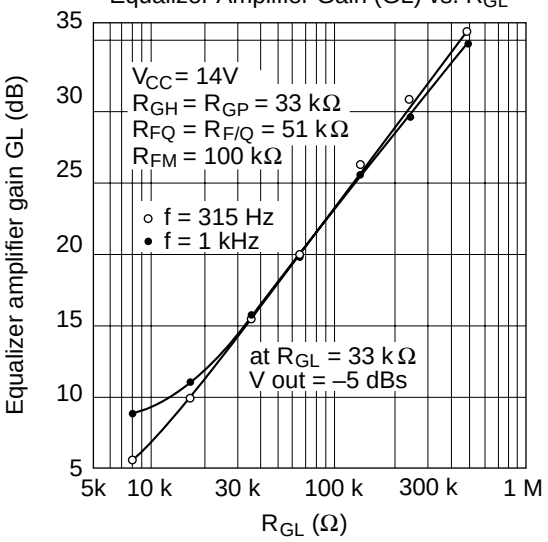
Equalizer Gain vs. Frequency



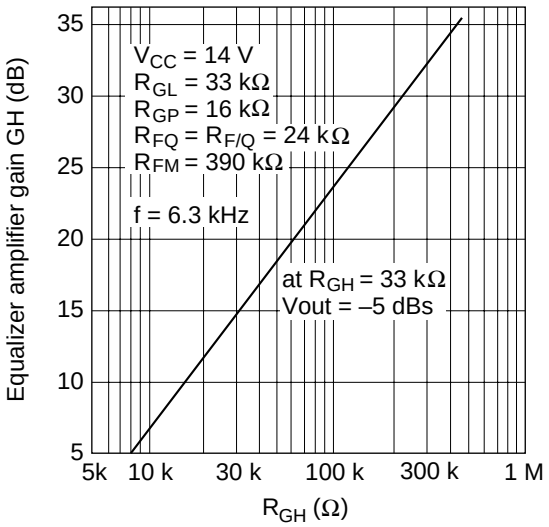
Equalizer Total Harmonic Distortion vs. Output Level



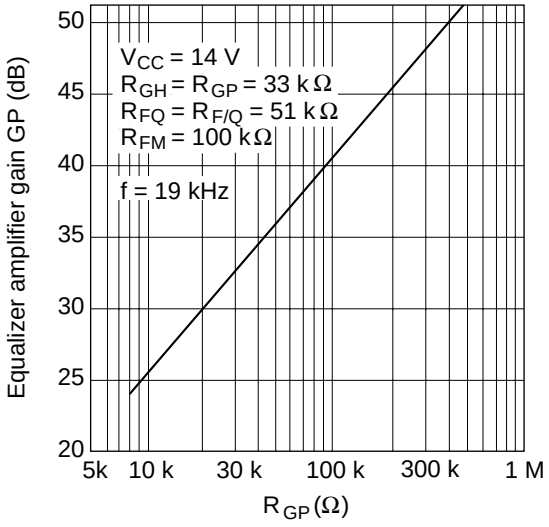
Equalizer Amplifier Gain (GL) vs. R_{GL}



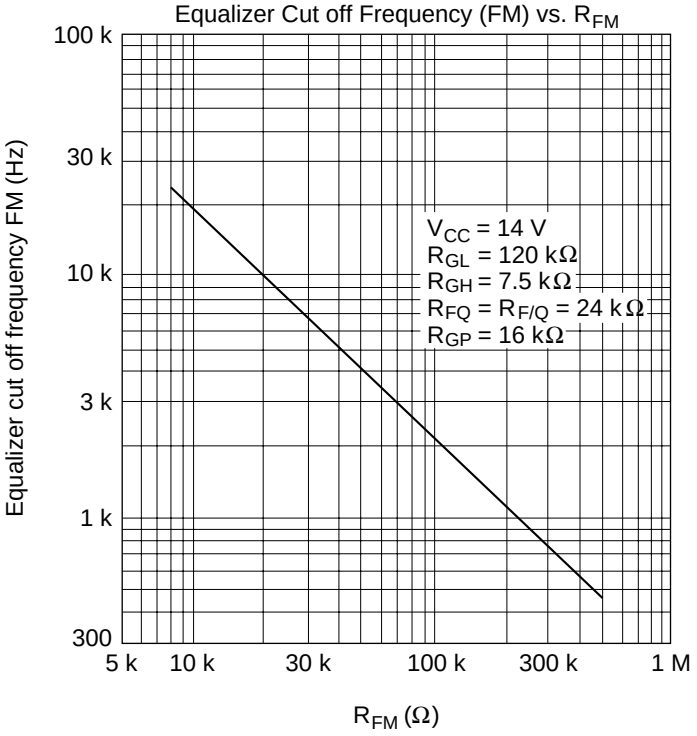
Equalizer Amplifier Gain (GH) vs. R_{GH}



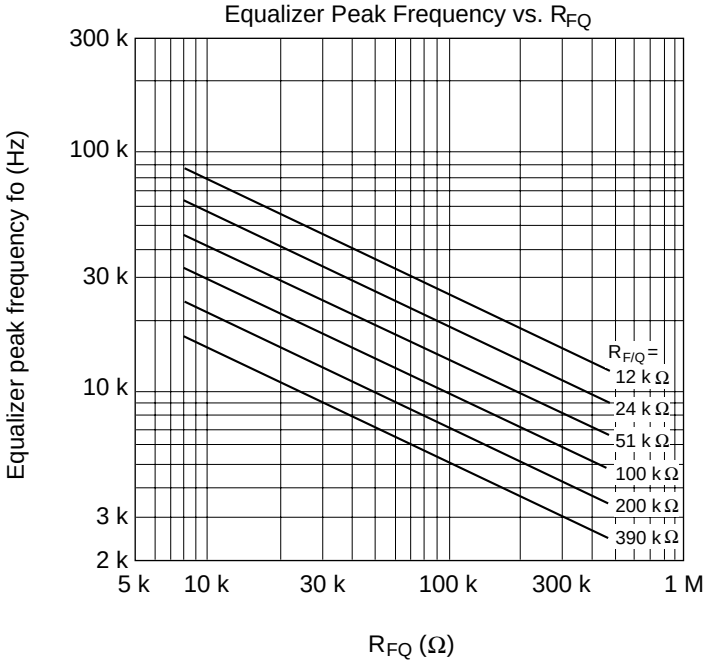
Equalizer Amplifier Gain (GP) vs. R_{GP}

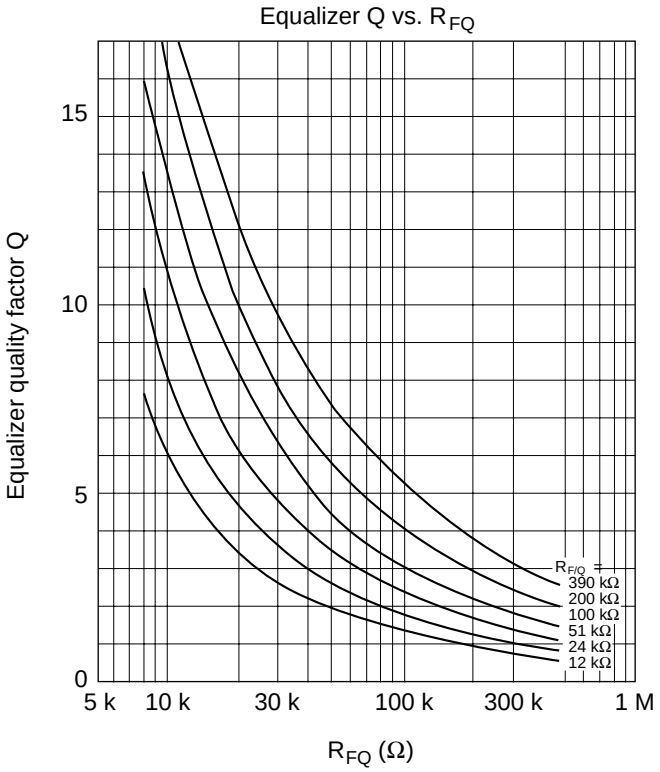


Equalizer Cut off Frequency (FM) vs. R_{FM}



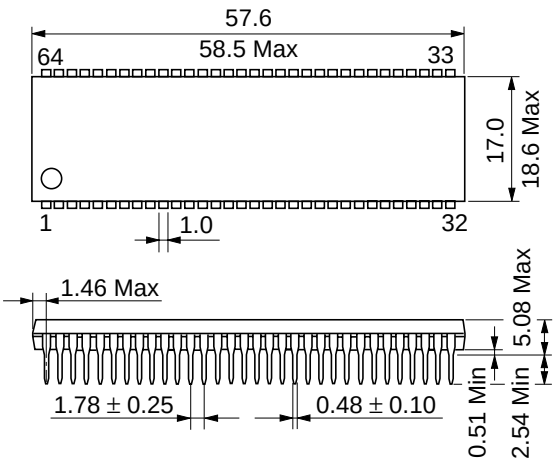
Equalizer Peak Frequency vs. R_{FQ}

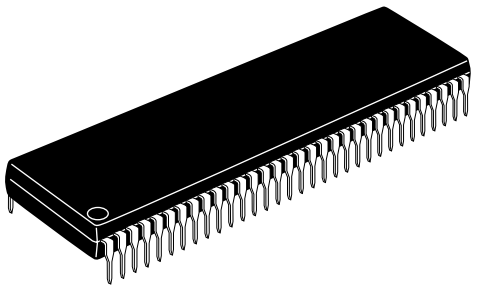


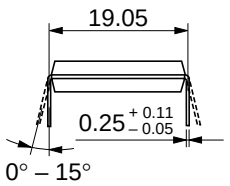

Equalizer Q vs. R_{FQ}
Equalizer quality factor Q
15
10
5
0
5 k
10 k
30 k
100 k
300 k
1 M
R_{FQ} (Ω)
$R_{F/Q}$ =
390 kΩ
200 kΩ
100 kΩ
51 kΩ
24 kΩ
12 kΩ

Package Dimensions

Unit: mm







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JEDEC	—
EIAJ	Conforms
Weight (reference value)	8.8 g

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